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A Weekly Review of Current Electrical Progress

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Vol. VIII. NEW YORK, JULY 10, 1886. No. 2.

ONCE more the report is current that the Western Union and Baltimore & Ohio companies desire to reach, or have already effected, a friendly arrangement, in place of the fierce competition that has heretofore existed between them. The public is informed that the Baltimore & Ohio is tired of losing money, but probably the Western Union people are just as weary, and for a like reason. Another story has it that a foreign syndicate, headed by Mr. Pierrepont Morgan, is to take all Mr. Gould's telegraph stock off his hands at 90, but considering the stock is now below 70, we may be pardoned for feeling rather incredulous. However, we should not be greatly surprised to see a cessation of the warfare, both on land and sea lines, at an early date. The "punishment" has been severe for some of the parties concerned.

MR. ALEXANDER BERNSTEIN'S system of running low resistance incandescent lamps in series, which we described in full in recent issues, is, as Prof. Ayrton point out, admirably adapted to temporary installations in connection with storage batteries requiring but from 6 to 8 volts E.M.F. Four such cells of sufficient current capacity would answer for a temporary installation, as they would give the required potential. We see no reason, however, why the use should be restricted to *temporary* installations even on this system. The idea of furnishing each house with storage batteries which are charged during the daytime from the central station and used at night would appear to be easily carried out on this system, in which, as is shown, the number of batteries required is very small. The subject is worthy of further investigation.

PROF. HUGHES, in the course of his classical experiments, has very naturally come to make a distinction between the inductive effect of a current in contiguous portions of the same wire and the effect within the body of the wire itself. It is the latter which he calls "self-induction" to distinguish it from the former, which he styles "mutual induction." These terms will be used in practice in the future, so that it may be well to draw attention to them now. Prof. Hughes is now enabled to explain in a most satisfactory manner the observations recorded in his first paper, in which he showed that a *stranded* iron wire had as little self-induction as one of copper, whereas a solid iron wire of equal section showed a largely increased amount. The cause assigned to this phenomenon by Prof. Hughes is the breaking up or prevention of the circular magnetism in the stranded iron wire. The question suggests itself, now that the method of making iron, in a measure, as efficient as copper for telegraph and telephone purposes has been pointed out, whether the movement for the introduction of copper wire for such purpose will continue. We are inclined to think that it will for the numerous reasons which have prompted its use in addition to its non-magnetic and non-retarding qualities.

As we are continually going higher and higher in electromotive force of our electrical circuits, the question of the insulating capacities of various materials becomes more and more important; not that the insulating value of most available materials is unknown, but because they have been employed under favorable circumstances and old conditions. Not only are insulators now required to endure increased potential, but they must also be capable of withstanding a certain amount of heat. But leaving the heat out of the question, the problem is presented of the relative values of insulating materials as now frequently employed. Dr. Fleming seems to suppose that the danger of rupture to insulating materials increases as the square of the electromotive force. But on the other hand, experience does not confirm this. Besides the high initial E. M. F. to be taken into account, there must also be considered the very much higher E. M. F. of the extra currents or those produced by self-induction. It is these which probably would tend more than anything else to the rupturing of the insulation, and would, of course, vary with the character of the machine and the current generated in it. Certain it is, that experience has shown that greater precautions than had been deemed necessary are found to be advisable in the insulation of high-potential dynamos, and recent events have demonstrated that extraordinary demands are made upon insulation when required to carry currents at a potential above 5,000 volts. The same difficulty of insulation was experienced in the first attempts to construct induction coils for long sparks, and it was not until Ruhmkorff pointed out the proper method that success was obtained. This consists, as is well known, in separating the layers of wire having the greatest difference of potential between them as far as possible from one another. But, while this method is applicable to the induction coil, it is problematical whether an efficient dynamo could be constructed on the same principle. We must, therefore, look to a better method of insulating our dynamos, if we are to increase the E. M. F. of the currents employed in the future.

ONE of the latest issues of the *Circular* of Johns Hopkins University contains a beautiful and suggestive anniversary address by Prof. H. A. Rowland, on the physical laboratory as an instrumentality in modern education. We are free to confess that, personally, we never hear or read any utterance of Prof. Rowland on such subjects without stimulus and benefit, and in the present instance the earnest appeal made by him in behalf of a fuller recognition of the value of research impresses us with the weight of a message coming from some lofty Sinai of science. To our way of thinking there are few finer definitions than this: "The object of education is not only to produce a man who *knows* but one who *does*; who makes his mark in the struggle of life and succeeds well in what he undertakes; who can solve the problems of nature and of humanity as they arise, and who, when he knows he is right, can boldly convince the world of the fact. Men of action are needed as well as men of thought." Never was there a more pregnant epigram than that, and while we remember that Prof. Rowland has preferred the quiet work of the laboratory to the more exoteric work of public instruction, we feel that he is after all in deep sympathy with those who endeavor to make all knowledge profitable in some way to mankind, and has also keen appreciation of "all those inventions which make the present age the Age of Electricity,"—of inventions which "follow in the train of physics, but are not physics." Yet Prof. Rowland is right in insisting that the physicist trained at a seat of learning must be taught to cultivate his science for its own sake. To use his impressive language: "For myself I value in a scientific mind most of all that love of truth, that care in its pursuit, and that humility of mind which makes the possibility of error always present, more than any other quality. This is the mind that has built up modern science to its present perfection, which has laid one stone upon the other with such care that it to-day offers to the world the most complete monument to human reason. This is the mind which is destined to govern the world in the future and to solve problems pertaining to politics and humanity as well as to inanimate nature. It is the only mind which appreciates the imperfections of the human reason and is thus careful to guard against them. It is the only mind that values the truth as it should be valued, and ignores all personal feeling in its pursuit. And this is the mind the physical laboratory is built to cultivate." It is well for Johns Hopkins University that she has a man who is able at once thus nobly to present the claims of a physical laboratory and to utilize the new conveniences that are to be placed at his command, in work of which the determination of the ohm is but a foretaste.

THE most valuable document thus far indited by the Commissioners of Electrical Subways in this city is that submitted by Mr. R. P. Flower, which we print in full elsewhere. We may in fact characterize it as one of national importance and, all things considered, it contains the essence of a practical settlement of the underground wire problem for our cities. After careful deliberation, the commissioners have formulated an opinion, that as a comprehensive tunnel system would be too expensive, the most practical form is that of a conduit in which the wires can be drawn in and out, and the material which they recommend is asphaltic concrete. The arguments that have been brought forward in support of such a system cannot be gainsaid, and while Mr. Flower states that in his opinion any system can be made to operate, the weight of evidence and past experience force him to the conclusion that the one selected is the most preferable. While wisely foreseeing the time when the application of electricity for light, power, etc., will become far more general than at present, the commission can naturally devote its attention only to the present necessities of the case; but its work will nevertheless be of great value for any enlargements that may be made. Of the adaptability of the material selected for the purpose of containing the wires there can be no question. That the subject has been thoroughly considered is manifest from the test to which the proposed material has been subjected in relation to the conditions which it will be required to fulfill when laid in our streets, both as regards the effect of heat from steam pipes and the action of water gas, salt water and other deteriorating influences. Now that the form and nature of the conduit have been practically determined upon, the question of its construction will be the next thing in order, and the commission already throws out the hint that that will be left in the hands of a construction company subject to supervision. This is probably the only alternative left to the commission, and, if properly carried out, the plan will be no obstacle to the early accomplishment of its purpose. The subject of patents, which may become important in the future work, is also touched upon in the report. It is safe to say we shall hear more of this in due time. The *details* of the system still remain to be considered, and here, we believe, the principal difficulties will be met. Probably those will in time be overcome, and it may be safely asserted that active operations will soon be begun looking to a consummation of the object for which the Subway Commission was created. New York will by-and-bye have an electrical underground system sure to surpass that of any other city in the world, and which will serve as a model to other American cities. The conviction, however, forces itself upon us, that the proximity to one another in which a large number of circuits of different character are to be laid, will hardly fail to aggravate induction troubles on the great body of wires. These will be telephone conductors, and it will be necessary to provide the best anti-induction device for them in the shape of the metallic circuit; and when such a comprehensive underground system is ready for the wires we sincerely hope to see the ground return abolished for such systems. The additional expense of a double circuit is not a considerable one, and while it would naturally require a change in central office apparatus we have enough faith in the progressive spirit of our telephone companies to assert that they will readily adopt a change which will conduce to a better service for their subscribers. We observe that many of the companies breathe opposition to the commission's plans, but that was to be expected, and their feeling will not be lessened by any exhibition of unfairness or by the evidence of an intention to foster a monopoly at their expense. Mr. Flower is the man to satisfy the companies as head of the commission, and will, we think, try to allay all discontent by straightforward, businesslike management of the whole work.

The Three Pan-Electric Reports.

Last week the Congressional Committee that has been investigating the Pan-Electric scandal presented its conclusions in the shape of three reports. The first, which has already been briefly noted in these columns, was handed in by Messrs. Ranney, Millard, Hanback and Moffat, all Republicans, and is an unqualified condemnation of Mr. Garland and all his associates. Fault is also found with the Administration for allowing suit to be brought in its name at national expense and upon the instigation of the Pan-Electric "conspirators" against the Bell patents. A left-handed compliment is paid the New York *Times*, of which it is affirmed that "its whole course and conduct since the controversy began has been in the line of the Pan-Electric interest, and of bitter hostility to the opposing interest. Mr. Van Benthuysen's communications and most of the editorials are in full harmony of tone and spirit."

The report of Messrs. Boyle, Oates, Eden and Hall, Democrats, exonerates Mr. Garland and his friends from blame. Beginning with the first publications touching the Pan-Electric Company, Mr. Boyle's report says it appears from Sypher's testimony that he furnished the original "history" to Prof. Bell with the hope that it might lead to his employment by the Bell company, while Hill, professing friendship for Mr. Garland, prepared other articles attacking him in relation to other matters, and tried to sell them to the newspapers, but did not succeed. After copious extracts from the evidence given by Messrs. Pulitzer, Dana and Jones, the report reaches the conclusion that neither the Bell nor Pan-Electric Company, nor their agents, have attempted to improperly influence officials through the press. An exhaustive history of the organization of the Pan-Electric Company is given. Messrs. Carlisle, Randall, Garland and their associates are then exonerated. The evidence, the report says, does not show that these gentlemen were admitted by the Messrs. Rogers with any expectation of profiting by their official positions or official action.

Mr. Hale, Democrat, while to a certain extent concurring with his political colleagues, preferred to make an individual report directed against the connection of public officers with corporations. He holds the officials to have been imprudent, but not vicious.

Mr. Boyle's report was accompanied by the following resolution:

Resolved, That a full, fair and exhaustive investigation has failed to adduce any evidence which tends to show that Attorney-General Garland, Solicitor-General Goode, Secretary Lamar, Indian Commissioner Atkins, Railroad Commissioner Johnston or Senator Harris, they being the officers named in the Pan-Electric publications of the newspaper press, which gave rise to this investigation, did any act, official or otherwise, connected with the matter investigated, which was dishonest, dishonorable or censurable.

The report, and the resolution (which is concurred in by Mr. Hale), were referred to the House calendar. Mr. Ranney, of Massachusetts, also submitted the report signed by the four Republican members of the committee. Mr. Hale, of Missouri, presented his individual views. These reports were placed upon the calendar. Mr. Reed, of Maine, reserved all points of order against the resolution accompanying Mr. Boyle's report; and Mr. Ranney, stating that the resolution had never been submitted to the committee or acted upon by it, also reserved all points.

A New Method of Making Carbons for Incandescent Lamps.

A method for this purpose devised by Mr. Alex. Bernstein consists in making a carbon filament entirely out of hard and dense carbon, which is obtained by the decomposition of a liquid or gaseous carbon compound, and without any filament to deposit on. In order to accomplish this the inventor uses a vessel containing a carbon compound, which is decomposible by heat, and which compound may be in the form of a liquid or vapor. On the bottom of the vessel he places a conductor, say a piece of copper, which is connected with the negative pole of a suitable current generator. Then he suspends a wire, which is connected with the positive pole of the generator, in such a way that it may be made to touch the copper, and can be gradually and slowly withdrawn from it by suitable mechanism. As soon as the wire is withdrawn from the copper an arc is formed between them, and as the greatest heat is at the end of the wire which forms the positive pole, a deposit of carbon takes place at the end of the wire. The deposit so formed shortens the arc, but if the wire is withdrawn at the same rate at which the deposit is formed the result will be that a filament is gradually formed at the end of the wire, which filament consists entirely of a hard and dense carbon. The filament may be of any length, and the thickness of it can be varied by the varying speed given to the motion of the wire.

An Arc Lamp for Incandescent Circuits.

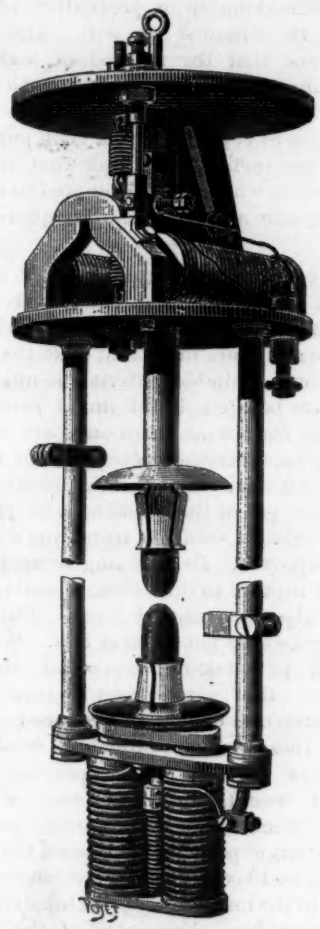
It is frequently desirable to connect arc lamps on incandescent lamp circuits, but the majority of arc lamps as constructed will not work to advantage in this way, as the principle of their mechanism does not contemplate their use in such situations. There was recently shown at the Antwerp Exhibition an arc lamp designed by M. Pieper, which was said to give very satisfactory results when coupled two in series on incandescent circuits of 100 volts.

The mechanism of the lamp, which is shown in the accompanying illustration, taken from *La Nature*, has two functions, viz., (1) the starting of the lamp, and (2) the regulation.

The starting of the lamp, that is, the separation of the carbons, is effected by an electro-magnet, shown below the lower carbon; this is wound with coarse wire in circuit with the two lamps, which when the current passes draws down the lower carbon a distance equal to the length of the arc, and maintains the lower carbon in that position as long as the current passes. When the current ceases an antagonistic spring raises the carbon until it comes in contact with the upper.

The regulation is effected by means of a fine wire electro-magnet placed in a shunt around the terminals of the lamp, at the upper end. The two cores of the magnet terminate in pole pieces, in front of which is placed an armature of soft iron. The latter is placed at one end of a lever, which oscillates on a horizontal axis, and is normally maintained in a raised position away from the pole-pieces by means of a spring.

The movement of this armature, caused by the attraction of the pole-pieces, breaks the fine wire circuit, and this causes a vibratory movement of the armature, in the same way as a vibrating bell operates. When the arc is at its normal length, the difference of potential at the terminals of the lamp is not sufficient to cause the electro-magnets to attract the armature against the force of the spring.



PIEPER ARC LAMP.

But as soon as the arc lengthens and the difference of potential increases, the armature is attracted and begins to vibrate. Each vibration produced a slight advancement or lowering of the upper carbon rod, which continues until the proper length of arc is again attained, when the action ceases.

The oscillation of the armature causes the disengagement of the carbon holder from a clamp or brake which holds it in position, while a spring-finger of steel, which presses obliquely against the rod, allows it to slide slowly downward. When the armature is no longer attracted, the spring-finger falls back and the clamp holds the rod as before. The mechanism resembles in its operation the rack and pinion movement of numerous arc lamps, but the teeth of which are infinitely small. The weight of the rod plays no part in the action of the vibrating electro-motor that causes the advancement of the carbon.

Meissonnier's Telegraph Picture.

One of Meissonnier's new pictures is to be entitled, "In the Telegraph Office." An operator sits at the instrument, repeating mechanically what the clicking key tells him to a young man very elegantly dressed, and whose excited, attentive expression contrasts strangely with the stolid indifference of the operator. This painting is considerably larger than Meissonnier's ordinary *genre* paintings. It is about two-thirds finished; but, incomplete as it is, it shows all the excellences of details for which the best of this class of Meissonnier's works are famous. Few painters, especially of the minor class, are ready and willing to let their unfinished productions be seen. Doré and Meissonnier are too great to have anything to conceal; and Meissonnier even receives his visitors, and chats with them, while working at his easel. Thus, he told a friend who called upon him recently at Ville-Ferme, how he had come to choose this subject. One day, in Paris, he was at a telegraph office, waiting for a dispatch. While there he saw the very scene upon which his masterly pencil is now at work. A young Englishman sat by the side of the operator, listening to what the latter told him from the sound of the key. M. Meissonnier was unable to hear what the instrument told him; but the scene interested him so greatly that the idea of reproducing it on canvas arose then and there in the painter's mind. In his usual painstaking manner, Meissonnier caused a telegraph instrument to be placed in his studio, and often watched the effect produced by the clicking noise upon people listening. The two heads are completed. They are simply splendid. The painting has already been sold for a large sum, but the price and the name of the purchaser are not published.

Changes in Iron Due to Magnetization.

Mr. Shelford Bidwell has been making further experiments on the changes produced by magnetization in the length of iron wires under tension. His results, as recently communicated to the Royal Society, disclose the following facts. An iron wire under tension, and subjected to a gradually increasing magnetizing force, is at first elongated, unless the load be great, then it returns to its original length, and finally it contracts. The maximum elongation diminishes as the load increases, according to a law which seems to vary with different qualities of iron. If the ratio of the weight to the sectional area of the wire exceeds a certain limit, the maximum elongation, if any, is so small that the instrument fails to detect it. The retraction due to a given magnetizing force is greater with heavy than with light loads. Both maximum elongation and neutrality (*i. e.*, absence of elongation and retraction) occur with smaller magnetizing currents when the load is heavy than when it is light; retraction, therefore, begins at an earlier stage. The phenomena both of retraction and elongation are, as might have been expected, greater for thin than for thick wires, and for soft than for hard iron.

Testing Metals by Thermo-Electricity.

MM. Pilleur and E. Jannetaz, according to the *Journal de Physique*, have endeavored to ascertain if, when a given point of a conductor is heated having a schistous texture, thermo-electric currents are produced in it. Their experiments extended to zinc, tin, iron and copper. The schistous or long-grain texture was imparted to them by carefully drawing out. A point *A* at the centre of the plate is heated and one contact is made on the other side of the plate, at the end of the line which connects this point with *B across the long grain*, the other taken at a point *C* on the end of the line joining the point *A along the long grain*. In all cases a current was obtained from *B* to *C*. The strength of the current for the same metal appeared connected with the development of the *long grain*. Thus that zinc which had passed four times through the draw-plate gave a feebler current than zinc which had been drawn out six times. But copper with a good deal of long grain, that is much more fragile in one direction than another, gave a feebler current than tin, which seemed to have no appreciable grain. It must, moreover, be observed that this tin had passed six times through the plate; hence the thermo-electric action shows the action of the draw-plate, even when the fracture does not show it. The strongest currents were shown by zinc, and the feeblest by copper. The currents are, however, difficult to observe, doubtless owing to the facility with which they unite across the plates themselves. More powerful effects may be obtained by cutting a knee-piece in the metal plate, in one branch of which the long grain is across and in the other in the direction of the length, and then joining the two ends of the knee-piece to the external circuit.

Belts in Lighting and Power Stations.

According to Mr. Wilfred Lewis, of Philadelphia, the following conclusions have been arrived at from experiments made on the transmission of power by belting: That the co-efficient of friction may vary under practical working conditions from 25 per cent. to 100 per cent.; that its value depends upon the nature and condition of the leather, the velocity of sliding, temperature and pressure; that an excessive amount of slip has a tendency to become greater and greater, until the belt finally leaves the pulley; that a belt will seldom remain upon a pulley when the slip exceeds 20 per cent.; that excessive slipping dries out the leather and leads toward the condition of minimum adhesion; that raw hide has a greater adhesion than tanned leather, giving a co-efficient of 100 per cent. at the moderate slip of 5′ per minute; that a velocity of sliding equal to .01 of the belt speed is not excessive; that the co-efficients in general use are rather below the average results obtained; that the sum of the tensions is not constant, but increases with the load to the maximum extent of about 33 per cent. with vertical belts and indefi-

nitely with horizontal belts; that, as the economy of belt transmission depends principally upon journal friction and slip, it is important to make the belt speed as high as possible within the limits of 5,000 or 6,000 feet per minute; that quarter-twist belts should be avoided; that it is preferable in all cases, from considerations of economy in wear on belt and power consumed, to use an intermediate guide pulley, so placed that the belt may run in either direction, and that the introduction of guide and carrying pulleys adds to the internal resistances an amount proportional to the friction of their journals.

The New York and Philadelphia Telephone Line.

In THE ELECTRICAL WORLD of May 22 was published a valuable paper, by Mr. Thos. D. Lockwood, on long-distance telephony, dealing with the earlier experiments and later achievements in that portion of the field. He described how the hard-drawn copper line between Boston and New York came to be constructed, and added, with regard to the new line between New York and Philadelphia: "The experience gained in building, testing and operating the Boston line has been utilized in the more recent one, which is a model line in many respects." That the commendation thus bestowed by an expert on the line constructed by the American Telephone and Telegraph Company for communication between the two largest cities in the country, one hundred miles apart, is thoroughly deserved, is admitted at once by all who have seen the work, and can appreciate the rare finish and thoroughness of that masterpiece of construction.

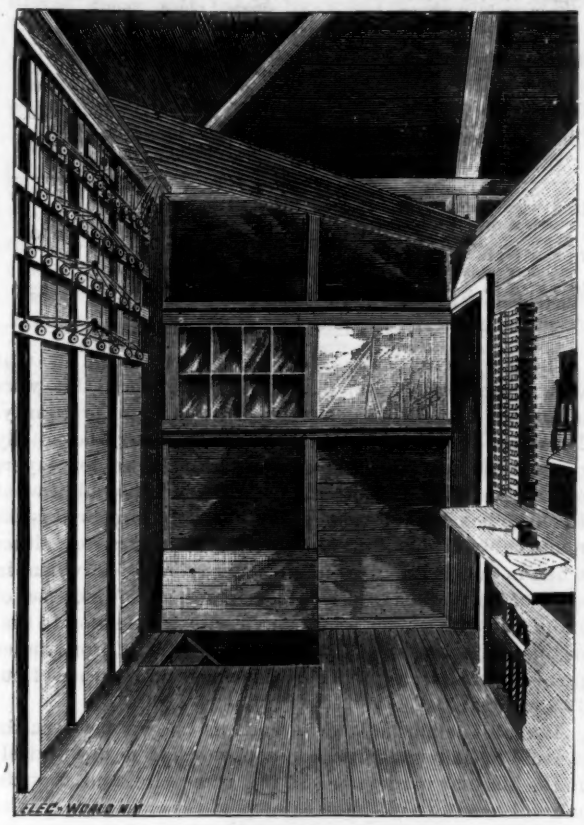


FIG. 1.—INTERIOR OF CABLE HOUSE.

The line was begun on August 18, and was completed through to Philadelphia, not including Jersey City, during January. Its total length is 102.6305 miles, being 98.8115 miles of pole line and 3.8190 miles of submarine cable. (The cables run a total length of about 20 miles of 7 conductors, as explained later.) The poles and cross-arms were carefully selected and rigidly inspected, and the utmost diligence and care was observed in carrying out the specifications relative to construction. The poles are from 45 to 70 feet in height, 7 inches at the top, secured by a substantial iron ring, with a heavy top pin, to which is attached a No. 8 iron guard-wire. Seven "gains" are cut in each of the poles, and at present three gains are occupied by ten-pin cross-arms, $3\frac{1}{4} \times 4\frac{1}{4}$ inches, braced the entire length from New York to Philadelphia with the Haskins bracer. The poles are planted to a depth of from 6 to 8 feet, and are pointed at the bottom. The guy wires are of wire rope, anchored to large boulders buried deeply in the earth. The poles are set 40 to the mile. The insulators are those known as the "Lewis pattern," and the pins are of split white oak timber.

There are at the present time 24 hard-drawn copper wires strung the entire distance of 102 miles, using a total of 2,400 miles of copper wire. The sizes are Nos. 12, 14 and 16 new British standard gauge, the different sizes being put up with the view of obtaining a comparative test of their respective merits. The outlay for wire alone must have amounted to a very large sum, but from the first no cheaper wire was considered. The desirability and the preferability of hard-drawn copper for long-distance operations have become too well known to admit of any other kind being thought of for such important, initiative work in the use of the telephone for conversation and business between cities widely separated.

The line is almost wholly a highway one; ten miles of it run parallel with the railroad, but all the rest follows the highway.

The company has had made specially for its purposes some of the largest cables for submarine and underground use ever laid in this country. Its entire cable equipment is of Day's kerite. The number of crossings between New York and Philadelphia are seven, viz., North River, twice across the Kills, Raritan, Rancocas and Delaware rivers, and in addition there is an underground cable across Ridgeway Park, opposite Philadelphia. Altogether, ten cables are used between New York and Philadelphia. The conductors in all the cables, with the exception of one series, are composed of three No. 18 B. W. G. copper wires with kerite insulation, measuring $\frac{9}{32}$ of an inch outside diameter, the submarine cables being armored with 18 armor wires, No. 4 B. W. G., each weighing 810 pounds to the mile.

One cable throughout the entire series has its conductors, which are seven in number, composed of three No. 16 B. W. G. copper wires stranded together, equal in weight to two hundred and ten pounds of copper to the mile, and insulated with kerite to an outside diameter of $\frac{11}{32}$ of an inch. These in turn are taped, laid up and served with packing to receive nineteen No. 3 B. W. G. galvanized iron armor wires, each weighing nine hundred and fifty pounds to the mile. The entire series of cables are four in number, of seven conductors each, making a total of 28 conductors. Conversation over the line is perfect, and this, to a great extent, is due to the low resistance of the conductors and their thorough insulation.

The shortest cables are 330 feet; the longest are 5,450 feet, and are those crossing the North River, between Jersey City and New York. On the New York shore, the cables land under a wharf at the foot of Vesey street, thence pass into a cable house, and the wires go by aërial cables up to the central office at 140 Fulton street, there making connection with the general telephonic system of New York City. At Philadelphia, the cables land near Walnut street.

The cable houses along the line are of a novel and most convenient design, displaying a remarkable evolution from the ordinary and customary forms described in our issue of June 26 by Mr. D. B. Macquarrie in his interesting article on river-cabling. We illustrate in Figs. 1 and 2 the interior and exterior of the cable house at which the cables connect in Jersey City. It is fairly typical of the houses throughout. It is built of wood with diagonal sheathing, covered with waterproof paper and weatherboarded over all. With their shingle-topped roofs, the houses are thus as impervious to water as any dwelling.

There are two stories or floors. The lower story, about 5 feet in height, is used for the storage of materials, etc. In it is placed the stairway communicating with the second story, which is 7 feet high. Here, high and dry, beyond the reach even of unusual flooding, are the wires, lightning arresters, etc. Near the centre of this room, which is about 7 feet square, is an upright framework covered with matched sheathing, upon which the lightning arresters are fixed. To the right of the arresters is placed a telephone set for the inspector's use in testing the wires. A shelf is fixed at convenient height upon which is ranged a row of cords, plugs and weights for the purpose of connecting the telephone set and for cross-connecting or "patching up" wires in case of trouble.

A long slot is cut in the sheathing directly back of the lightning arresters, which allows the light from the windows to penetrate, and enables the inspector to discover any defects that may have arisen from a heavy discharge or other cause. The wires are taken in regular order from the arresters, and carried over the tops of the frame to the side of the house, and then down through cleats to porcelain insulators arranged on the inside of the house in proper order to receive the outside wires. A sufficient quantity of wire is wound around itself at each to serve for future use. Kerite wire is brought from the outside in rubber tubes, set at an angle through the side of the house. The wires are then brought down to a point just above the porcelain knobs, where the inside wire is bared and a connection is effected. This joint is afterward covered with kerite tape. It will be noted that there are no uncovered points for an escape except the rubber surface of the lightning arresters, and the favorable position of the latter eliminates any danger of escape there.

The copper conductors of which the line-wire is composed, afford an excellent thoroughfare for heavy electrical discharge. For this reason the arresters at the cable house have been designed with a special regard to the work that they have to perform, and the details of the construction embrace many novel and valuable contrivances. A glance at Figs. 1 and 3, with a brief description, will enable our readers to understand fully these peculiarities.

The arresters are constructed in groups of ten, and are so arranged as to be conveniently joined together to an unlimited extent. The board carrying them consists of an oblong mahogany frame, upon which are screwed two plates of hard rubber one quarter of an inch in thickness. Upon these plates are placed the heavy brass mountings or points to which the line and cable wires are attached. By this means the leakage due to the absorption of moisture by the wood, as usual in the ordinary method, is avoided. Leakage, if there be any, must come exclusively from the surface, and that is normally dry. A fine galvanometer test shows no escape, but a breath on the surface will deflect the needle. A heavy brass ground bar is placed on the centre of the frame, and to one side of this bar are presented the line points in the form of saw teeth. This bar is connected to ground by means of a very large copper wire. The points or mountings are of extremely thick brass, and are intended to afford protection to the line as well as to relieve the fuse wires from excessive burden. The fuse wires are of soft silk-covered copper, .008 diameter, and coated with a solution of okonite. The wire shows an insulation of a half megohm per 1,000 feet after an immersion of 20 hours in water. One end of the fuse wire is attached to the screw on the line point, passed once around the brass stud in the ground plate and separated therefrom by paraffine paper; then passed under the screw head of the cable point and drawn taut. The line points are in two pieces and are connected by a screw plug, which furnishes an excellent connection and is an absolute guard against "working loose" or dropping out, as is often the case with taper plugs. These plugs are provided with a coarse screw thread, so that the same amount of turning required to set a taper plug will send them home.

This arrangement of arresters is free from the fatal defect, not uncommon, of having an obscure, un-get-at-able point liable to be overlooked or neglected by the inspector. The most cursory glance will suffice to make plain any trouble with the system. The removal of the screw plug opens the line and the holes drilled or tapped in both the line and cable points, and permits tests to be made in either direction without disturbing the wires.

There are three windows in the cable house, one on either side and one directly behind the lightning arresters, or the purpose, described above, of "getting more light

FIG. 2.—TELEPHONE CABLE HOUSE, JERSEY CITY.

upon the subject." The windows are protected by hinged, battened blinds that close tightly, and are kept bolted. The structure is painted in quiet but effective colors, and] has one or two little architectural touches about it that relieve it of the reproach of being grimly utilitarian. The Jersey City house is well portrayed in our illustration, and is very far from being the least picturesque object along the Jersey shore of the Hudson.

It must also be mentioned that a test station has been located at Freehold, N. J. A lot was purchased by the company, directly under the line, at a point near the railway station, and a handsome cottage has been erected. It is provided with a tower for the reception of the wires, and on the ground floor of the tower is placed a test board of peculiar design with spring jacks, and flat insulated plugs with cords and weights, adapted to "patch up" lines quickly in case of trouble. A line inspector will be permanently located at this station.

As intimated above, the line is the property of the American Telephone and Telegraph Company, of which Mr. Theodore N. Vail is president and Mr. Edward J. Hall, Jr., general manager. Many of the ingenious features in the work are the invention of Mr. T. B. Doolittle, whose fertility of resource in this department of electrical application is well known. The construction has been carried out and personally superintended by Mr. W. H. Fairbank, assisted by Mr. H. P. Marshall as agent of supplies. Mr. Fairbank's deputies were Messrs. C. T. Fitch, H. D. McCaffrey, A. S. Campbell, J. Doyle and A. E. Crocker. The long North River kerite cables were laid by Mr. F. M. Ricketts,

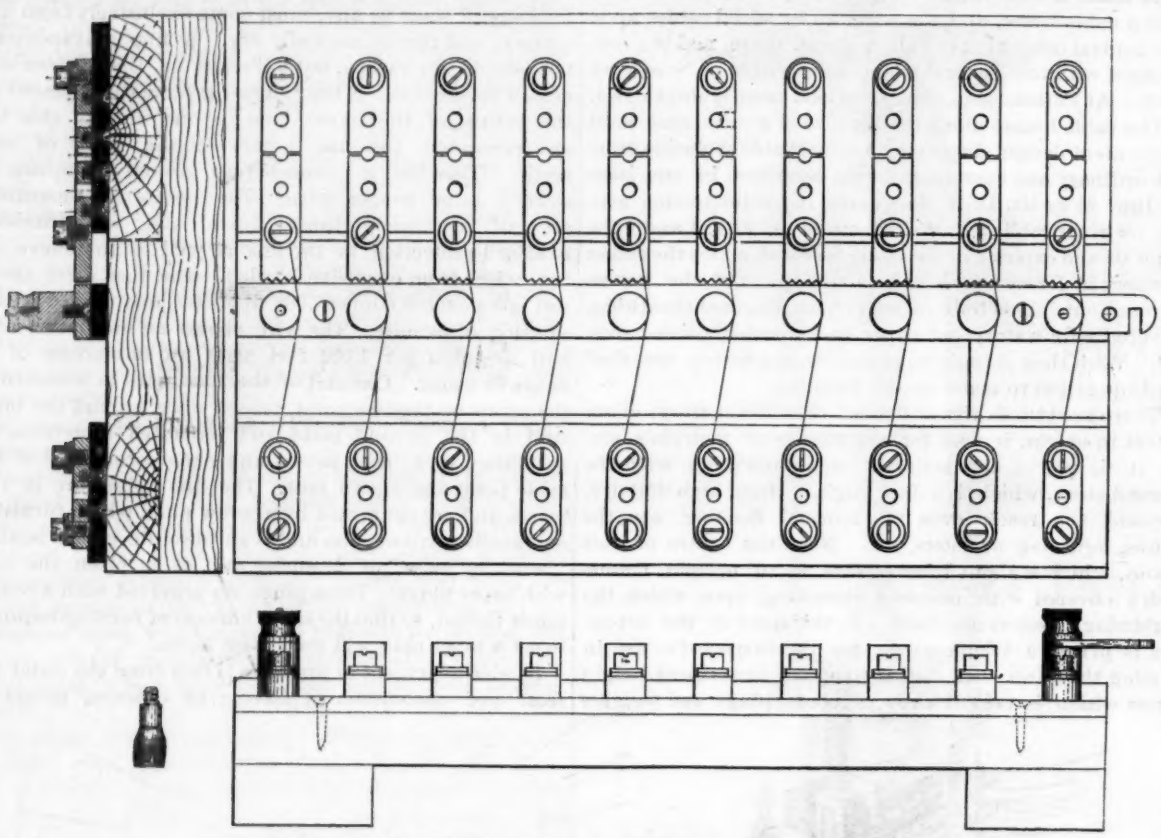


FIG. 3.—DETAILS OF LIGHTNING ARRESTERS.

with the direct supervision of Mr. Clark B. Hotchkiss. From first to last the line is flawless, reflecting the utmost credit on all concerned.

Researches Upon the Self-Induction of an Electric Current.*

BY PROF. D. E. HUGHES, F.R.S.

(*Continued.*)

INFLUENCE OF THE NATURE OF THE CONDUCTOR UPON ITS SELF-INDUCTION.

I found, as shown in my late paper, that there was a marked difference in the specific inductive capacity of iron and copper, and this entirely agrees with well-known theories; but I suspected that there might be some difference in the non-magnetic metals independent of their specific resistance. For this purpose I made a series of experiments with wires of the same length and diameter, but of different resistance. These showed a marked difference provided the current was increased in proportion to the diameter or conductivity, but no difference could be found when the current was kept a constant, and the interior differences in resistance of the wires were compensated by an external added resistance; but if we take wires of different metals—all of the same length and resistance, but of different diameters—there is a marked difference due to the mutual reactions of the current in its own wire, being less in wire of large diameter than in small wires. These effects have been fully explained in my late paper, and have since been completely verified by the method used at present. I showed by the use of my late method a critical point in the rise and fall of the induced currents; this is not shown by the present method of compensating by external resistance, but the rapid decrease in the electromotive force of the induced currents, as indicated by the induction balance, is well shown by the present method. The following table shows the observed force of the extra currents for wires of the same length (1 metre), but of different diameters:

	mm. 0.25	mm. 0.50	mm 1.00	mm. 2.00	mm. 3.00	mm. 4.00	mm. 5.00	mm. 6.00	mm. 7.00	mm. 8.00	mm. 9 00	mm. 10.00
Iron.....	760	621	530	360	289	230	190	171	152	138	128	124
Copper....	129	113	100	89	82	78	75	73	72	71.5	71.2	71

The fall in force is now even more rapid than shown by my late method, and it will be seen that iron is peculiarly sensitive to an increase in diameter, having nearly six times the force of copper in wires of 0.25 mm., and not twice the force of copper in wires of 10 mm section.

REACTIONS OF AN ELECTRIC CURRENT IN ITS OWN PORTION OF CONDUCTOR.

The phenomenon of a constant decrease in the electromotive force of self-induction, as measured by the induction balance, with each increase of the sectional area of the conductor is well shown by the present method, and an experimental investigation of its cause has shown that we should not consider a current in a wire as a single element reacting solely upon exterior wires, but that the current acts precisely similar as would an infinite number of independent streamlets of current reacting upon each other in the interior of its own wire similar to their known effects upon exterior wires. My experiments demonstrate this to a degree that leaves no doubt on my mind as to its truth, for according to this view we should be able to reduce the self-induction to a very great extent by employing thin flat sheets where the outlying portions are at a comparatively great distance from the central portions. This I have experimentally proved to be the fact, but this experiment alone does not show if the reduction of self-induction is due to a different arrangement of the current in sheets as compared with solids. If the reduction is due to the greater separation of the streamlets, then we should be able to reduce this induction in a still greater degree by employing a conductor composed of numerous small copper wires through which the current is equally divided, and which could be separated or brought close together as desired. This proves to be also an experimental fact, for the conductor formed of numerous strands has far less self-induction than a thin sheet when its wires are separated, so that they can no longer react on each other, and surpasses the thin sheet and approaches the value of a circular wire when these wires are brought near together, so that their mutual reactions can approximate those of the numerous streamlets in a solid conductor.

Iron shows a still greater reduction in its self-induction when in the form of thin flat sheets or numerous small iron wires separated from each other, with the exception that we cannot restore or approach the value of a solid wire by bringing them in close proximity. The reduction of the induced currents by employing thin sheets instead of a wire is so great in iron that we could not account for it on the mere separation of contiguous portions of the same current, but if we assume that the comparatively high force in iron wires is due to the induced circular magnetism, and that this almost disappears in flat sheets, we account for the fact that a thin flat sheet of iron has less inductive capacity than a similar sheet of copper of the same resistance, but of different widths; and if thin strips of copper, brass, lead and German silver are compared with similar iron strips, and their resistance rendered equal by the added resistance in the bridge, no difference is found between iron and the non-magnetic metals, for under these conditions their inductive capacities appear equal.

REACTIONS OF AN ELECTRIC CURRENT BETWEEN SEPARATE PORTIONS OF THE SAME CONDUCTOR.

In order to distinguish two distinct effects, I have defined self-induction as the effect produced by an electric current on its own portion of the wire, and mutual induction as the effect of the reactions between separate portions of the wire on each other.

The mutual induction in iron and copper wires is very different in degree, as shown by the following table:

TABLE I.

Wires, silk-covered, 1 m. in length, 1 mm. in diameter.	Comparative force of the extra currents.	Strips or ribbons, silk-covered, 1 m. in length, 10 cm. wide, 0.1 mm. thick.	Comparative force of the extra currents.
Copper wire, in a single close loop where each side is in close proximity.....	18	Copper strip, in a single close loop where each side is in close proximity..	14
Copper wire, in a single wide circular loop.....	100	Copper strip, in a single wide circular loop.....	60
Copper wire, in a coil of 3 cm. diam., having ten layers in close proximity....	607	Copper strip, in a coil of 3 cm. diam., having ten layers in close proximity	580
Iron wire (soft), in a single close loop, as above	440	Iron strip (soft) in a single close loop, as above	16
Iron wire, in a single circular wide loop...	502	Iron strip, in a single circular wide loop..	60
Iron wire, in a coil, as in the case of copper	570	Iron strip, in a coil as stated for copper...	578

There is a remarkable fall in the induction of a straight wire or single wide loop of a copper wire when this wire is doubled upon itself as a return wire in close proximity. The effect of mutual induction is also shown by the equally remarkable rise when the mutual induction of ten layers of a coil react on each other. This is well known, but what I believe has not yet been experimentally observed is the remarkably feeble mutual induction of iron wires, either when in parallel return in close proximity or when in coils of numerous layers, the percentage of increase of induction in a copper wire from a wide single loop to that of the ten layers being 507 per cent., while in iron under precisely the same conditions there was an increase of but 13·6 per cent.

That this remarkable difference as shown between the mutual induction of iron and copper wires is due entirely to the circular magnetism in the iron wire, and that the mutual reactions of the streamlets of the current in a thin, flat iron conductor prevent this formation I have proved in various ways, for if the circular magnetism is the cause, flat iron sheets which have as low self-induction as copper should be equally sensitive to mutual induction as the non-magnetic metals, for they no longer in any appreciable degree possess the protecting magnetic sheath which enfeebles the mutual reactions of iron wires upon each other; this proves to be the case, a thin ribbon of iron having the same co-efficient of mutual induction as copper, and it no longer behaves as a magnetic body.

Table I. shows the difference in the mutual induction of iron wires and strips; it will be seen that when the iron is in the form of a wire the circular magnetism produces a marked difference between iron and copper, while in the form of flat strips the iron resembles copper (as regards mutual induction) in every respect.

INFLUENCE OF CIRCULAR MAGNETISM.

I have shown in my late paper that an iron conductor composed of numerous fine stranded wires (as in a rope) behaves like copper, and this I regard as entirely due to the breaking up or prevention of circular magnetism; I also showed a phenomenon which I could not then explain, viz., that when an iron wire was heated to a yellow-red heat it lost its previous high specific inductive capacity and behaved like copper. The effect of heat upon magnetism is well known, consequently we can readily explain the fall in its inductive capacity by the disappearance of its circular magnetism. I found also that in thin flat strips of iron there was no change whatever in its inductive capacity at the yellow-red heat; this can now be readily explained: it behaved like copper when cold, and, having but little circular magnetism to destroy, there was no appreciable change produced, except that due to the extra resistance caused by the increased temperature of the strip, and to which copper and iron are almost equally sensitive, consequently we may consider iron (when in the form of thin flat sheets) to behave like non-magnetic metals throughout all temperatures.

(TO BE CONTINUED.)

* Read at the Royal Society, May 27, 1886.

A Portable Electric Lamp.

M. Larochelle's portable electric lamp has found much favor in Paris. The battery is inclosed in the lower part, and consists of an ebonite vessel divided into eight compartments by partitions, furnishing eight cells, or elements, in a very compact form. The vessel will hold about three liters of liquid, capable of acting for about eight hours without exhaustion. Each element is made up of a rod of zinc and two rods of carbon fixed to a disk, which can be lowered into the liquid or lifted out of it by turning a key like that used in a Carcel oil lamp, and the power of the light is regulated by the depth to which the zincs and carbons are immersed.

"Engine" Dynamo and Motor.

As the result of many experiments and trials, extending over some years, on dynamo machines, Mr. Henry Joel has designed, in England, a form of dynamo which he terms an "engine" dynamo, and which is represented in our illustrations. It is so named from its being manufactured by machinery, in detached pieces, all made to gauge, and interchangeable, so that, in case of any portion being damaged, it is only necessary to detach that portion, and forward it for repairs.

Fig. 1 shows the dynamo with its adjustable bed-plate and screw-tightening gear; two pulleys (fast and loose) are also shown for driving purposes. The two field magnets are vertical, with massive cores of soft wrought iron carefully annealed, and are of extremely simple form, united above and below by yokes of selected cast iron, which are specially formed so as to serve also as pole pieces. The field magnet coils are not, as usual, wound direct on to the iron cores, but are wound on to a bobbin fitting the cores, so that in case of any damage to the wires they can be easily taken off and repaired without the removal of the magnets and similar heavy trouble. The pole pieces have their under faces grooved so as to break up eddy currents and accumulate the magnetic effects as much as possible at the centre of the poles, rendering the magnetic field as strong as possible.

The armature which is shown in Fig. 2 is a modified Pacinotti ring, and is built up of interlocking segments bolted together. These segments may be seen in Fig. 3; they consist of laminated Swedish iron plates punched with the tooth-shaped projection alternately at one end: these thin plates are insulated from each other, except at the junctions of the sections, where iron is pressed in contact with iron to form a series of continuous rings.

The sections when complete are made to fit and interlock, and they are secured with insulated bolts of non-magnetic material. They form when built up in this manner the outer rim of the ring armature, as seen. The coils for the armature are specially wound to exact size in detachable portions and slipped or threaded into the core sections; they can, therefore, be easily removed in case of any of them being damaged.

The commutator and brushes being on the opposite side of the machine, cannot be seen, but it may be stated that the arrangement of the commutator is special; it is fixed close to the armature coils, and the connection between the ends of the coils and the commutator bars is so made that the joints are without solder, and can be easily disconnected and re-connected. The brushes are fixed on the end of the axle (which is made of steel, and is very short with a long bearing), and are easily adjustable, but little trouble being required to remove them from contact with the commutator, or when in contact to keep them clamped in the same position.

Experiments which have been made with these machines, says the *Mechanical World*, show that they possess very high efficiency, results which have been confirmed in practical use, but the advantages claimed for this dynamo specially are the perfected manner of manufacture and the changeability of the various parts of the machine, in consequence of the whole machine being built up of detachable parts, enabling any damaged portion to be at once withdrawn and replaced by a spare section or be easily repaired; the armature, for instance, can be easily taken to pieces and as easily put together again; the coils of the field-magnets can be changed for coils giving higher or lower resistance, but from the exactness of the manufacture and the strength of the various parts, it is not expected that parts will get out of order except from accidents, which at times may happen, and on the occurrence of such an event the replacement of the part affected can be easily accomplished with the least possible delay.

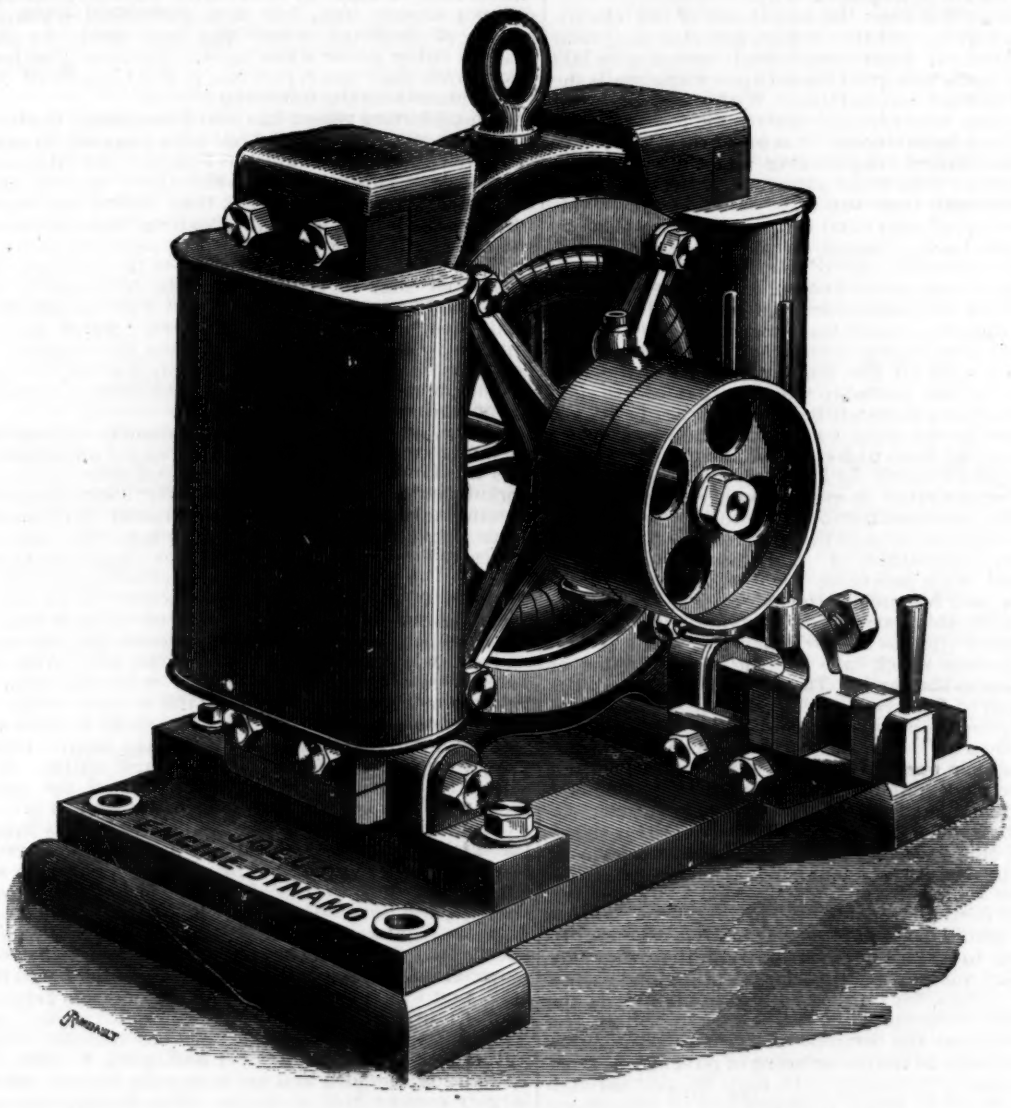


FIG. 1.—JOEL'S "ENGINE" DYNAMO.

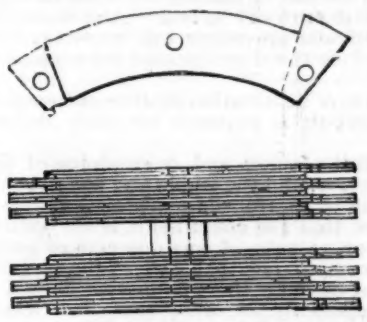


FIG. 3.—SECTIONS OF ARMATURE.

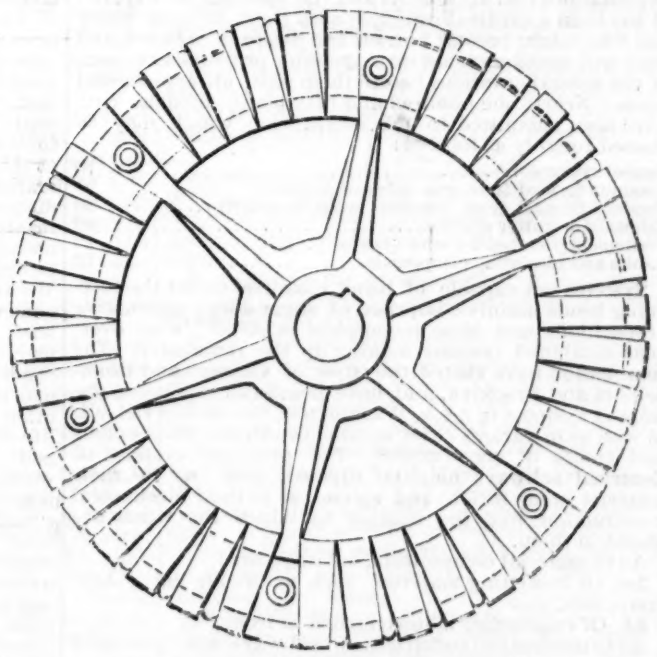


FIG. 2.—SECTIONAL ARMATURE.

Mr. Woodbury and Electric Railways.

To the Editor of The Electrical World:

SIR: I think some of your correspondents have misunderstood Mr. Woodbury's position on the matter of elevated electrical railroads for Boston, as also involving an opposition to all electrical roads, for in his testimony before the committee he avoided any such statements, and it is to my knowledge that in reply to questions subsequent to that hearing, he urged several members to vote for granting charters for the surface electrical railways at Newton and at Winthrop, for the reason that every facility should be given to any measure which would give an opportunity to the further development of electrical railways. Any statement that Mr. Woodbury has any wish to discourage any useful application of electricity is an assumption which could be made only by those ignorant of that gentleman's work in advancing the applications of electricity, particularly in regard to introduction of electric lights, watchman's electric clocks and electric fire-alarms in the mills, insured by those insurance companies with which he has been connected for many years.

People not acquainted with the electric light business have little knowledge of the opposition which he encountered in the early days of electric lighting. Maintaining that his views on the safety of electric lighting were well grounded, on sound principles, he urged underwriters to encourage their introduction, as furnishing a better and safer illumination, and the results have justified what was then a bold position. I believe that he is correct in stating that there is no exact precedent for the elevated electric railways proposed for Boston, and believe that the defeat of the measure was brought on, because the issue was forced a year too early. I trust that the developments of electrical invention during the coming year will show what can be expected of electrical railways on a large scale. It is no kindness to electrical interests to exaggerate the success of any invention, and this set-back at Boston, I trust, will never be repeated.

GEO. H. ADAMS.

PROVIDENCE, R. I.

The New Orleans Telephone Case.

To the Editor of The Electrical World:

SIR: In a letter dated April 25th and published in your paper, Mr. Van Benthuysen makes answer to my letter as published in your issue of April 24th. He denies that he had any wrong motive in suppressing what I consider his main defense. I am not concerned with his motive. He and Mr. Storrow are directly at issue as to the facts in this matter. Mr. Van Benthuysen says he attaches no importance to any statement the Bell attorneys make "unless corroborated by actual proof." The Bell attorneys have not been heard from, but it is not likely that Mr. Van Benthuysen expects more than he gives.

Mr. Van Benthuysen certainly has a legal right to conduct his case in any manner he chooses, if he protects his own stockholders. He claims that my affidavit was left out because I could not furnish the instrument with which I experimented. He will remember that in January last I wrote him that this instrument was not in my possession and that I informed him where it was. I have reason to believe that it was in New Orleans during the suit. But when his conduct of the case gives evidence that he has probably made a secret compromise with the Bell people, at the same time carrying on the case to the prejudice of the approaching government suit, it need not surprise him if this is pointed out. The rights of the people of the United States were not represented at New Orleans. The financial interests of private corporations only were represented.

Was it not singular that in this case no scientific man was allowed to testify? The only "experts" wanted were those who were unable to operate the Bell instrument of 1876. Of course, the Bell lawyers did not dare to place any scientific man of eminence upon the stand, for they knew that the evidence of such men would be fatal to their case. The Bell lawyers themselves understand so thoroughly every detail of their case that they have no difficulty in overwhelming the "experts" on the other side. They know that they cannot get expert aid which would do them any good, and they have prepared themselves so thoroughly that they can do without it if their opponents make a sham defense.

Mr. Van Benthuysen says I am "in error with reference to the working of Fig. 7 instruments in court here. It was not done." When he wrote that statement the decision of the court had not been rendered. The decision states that it was done. The judges expressly say that they had the evidence of their own senses on that point. They also say that the Reis instrument as he made it will not operate, from which I infer that Mr. Van Benthuysen did not operate it, although the record of the case shows that Mr. Beckwith was invited to operate it, by the Bell lawyers. Why did he not do it? This was the vital point in his defense, and here he failed. Perhaps his experts, who could not operate the Bell instrument of 1876, also failed to operate the Reis instrument of 1862. It is very easy to find men who cannot do things which others can do

As to the result of this litigation I am wholly indifferent. But I wish it distinctly understood that the absurd defense at New Orleans was very different from the one which was marked out by Dr. Adams, and to most of which I gave approval. The defense at New Orleans is something like what I should have made if I had desired to allow the Bell Company to win the case. Whether this was due to the singular trait which most lawyers have, of imagining that they have mastered the science of electricity after a few weeks of cramming, or whether the suit was a collusive one, in which the interests of both sides were identical, is a matter which each must decide for himself, as I have done.

FRANCIS E. NIPHER.

ST. LOUIS, June 26, 1886.

Report of the New York Electrical Subway Commission.

The following report was presented on June 30 by Mr. R. P. Flower at the meeting of the Commission and adopted:

The work of the commission is capable of being divided and subdivided into a series of questions, each of which can be provided for as it comes up by resolution of the commission. I have made certain of these divisions, which I will lay before the commission.

Some of the questions have been thoroughly considered by the commission, and I believe we are prepared to vote upon them at this time; others have not yet been considered, and I have certain propositions to make looking to our better information in respect to these.

The questions I have to propose are these:

1st. What form of subway will the commission adopt? Under this question arise the following:

(1.) Material to be used.

(2.) Form and method of placing the wires therein.

2d. How shall the subway be laid? And under this:

(1.) What particular provisions are necessary for each different kind of electrical service, and for each particular locality.

(2.) What mode of distribution shall be enforced.

(3.) What capacity is required for each different locality

3d. How shall the laying and maintaining of the subway be provided for, and the whole and parts thereof and the wires therein be controlled.

I am advised that the commission is not bound to accept the plans or patents of any one man or number of men, and it seems to me that each of the several questions to be acted upon by the commission should be met separately and distinctly, in order that that which is at best merely experimental may be tried in the best manner possible.

First, then, as to the form or plan of subway, its material, and the manner of placing the wires in it.

The commission have had before them many plans and forms of subway and have devoted much time to hearing explanations and arguments and the opinions of experts. It has been a cardinal principle with them to hear every one who might present himself and desire to be heard, and they will continue to act upon the same principle as to each of the several questions before them until all are decided upon. Nearly one hundred and fifty plans, models, &c., have been submitted to the commission which may be classed roughly as follows:

Tunnel systems	10
Conduits formed from iron tubes or sections	10
Conduits formed from concrete, wood or masonry	20
Sidewalk or gutter systems	20
Permanently embedded wire systems	12
Cables and insulating compounds	12

Systems not capable of being classified under the foregoing heads mainly comprised of suggestions, alternative propositions and ideas incomplete in detail, with overhead combined systems making up the remainder. The commission have visited the cities of Chicago and Philadelphia and Brooklyn, and have heard full reports of the subway systems in use in Washington, Boston and Detroit, as well as in various cities in other countries—their extent and modes of construction. The principal systems of electrical subways may be divided, first, as to their material composition, and second, as to their mechanical construction, and the manner in which the wires are placed in them.

As to material composition, subways are:

1st. Of insulating material, such as wood, glass, concrete, etc., etc.

2d. Of conducting material, such as iron.

As to mechanical construction, subways are, generally speaking:

1st. Tunnel systems.

2d. "Drawing-in" systems.

3d. Solid systems.

4th "Dropping-in" systems.

5th Combined systems.

Tunnel systems, or those where space is provided underground sufficient to allow the passage to and fro of men who place the wires within the subway could be recommended, were unlimited time and money at the disposal of the commission; but the expense of such a system and the crying need of immediate action, preclude the adoption of such a plan. If ever underground railroads become a feature of our city transportation, then, perhaps, the tunnel can be used for some of the future trunk line cables. In Paris, where the foundations of the city are honeycombed in all directions by large sewers, such a plan is practicable and admirable, but not to be thought of in New York.

Drawing-in systems, or those where man-holes are provided in the streets, connected by tubes or pipes through which the wires can be drawn, are next in prominence and convenience to tunnel systems. In Chicago there were seen in successful operation nearly twenty miles of conduits of the "drawing-in-and-out" pattern of various materials, containing all kinds of wires, as follows: Eight miles of the Dorsett system of concrete conduit divided into ducts, and containing in the separate ducts wires of the city telephone, telegraph and fire service, electric light wires and wires of different telegraph companies. Four miles of the Johnstone system of iron conduit divided by metal shelves, and carrying the wires of the Postal Telegraph Company. One mile of 3-inch iron pipes, four in number, carrying the wires of the Western Union Telegraph Company. Three miles of iron pipes, carrying the wires of the Bankers and Merchants' Telegraph Company. In Philadelphia a comprehensive "drawing-in" system of iron was seen, containing electric light and telephone and telegraph wires. In Boston some two miles of such "drawing-in" iron systems are in operation. In London 9,000 miles of wire are underground, bunched into cables and drawn into 3-inch iron pipes.

Solid systems, or those where wires are permanently embedded in insulating material and incapable of being reached, except by tearing up the streets and the insulation, have been found to work with more or less success. The commissioners saw several miles of this conduit in successful operation in Chicago by the telephone company there, where wires were buried in an asphalt or coal-tar cement, laid in a wooden trough. Several miles of similar conduit are in use in Washington for electric lighting, and there are other instances of the successful operation of this description of conduit. In this City of New York there are several systems in use underground, each more or less satisfactory to those employing it. A prominent example is the Brooks system used by the Metropolitan Telephone and Telegraph Company. It consists of an iron tube in which cotton-wrapped wires are drawn, and the tube filled with oil, the oil acting as an insulating medium. It is kept at a desired pressure—the tubes constantly full—by means of a stand-pipe. They use a two and a half-inch iron pipe, and the system is cheap, costing less than $11 per mile of wire, because into such a pipe they can draw 300 telephone wires. Wires for telephone purposes, and those used in the American District and other call boxes, are of a very light intensity, and do not need as heavy insulation as do all other kinds. This system is claimed to give perfect satisfaction for telephone conductors. The Western Union Telegraph Company has many wires already down in this city laid in 3-inch iron pipes, into which they drew cables manufactured from okonite or kerite insulation. These pipes are lead-jointed, are laid in Broadway, and have man-holes occasionally for taking out the wire.

To sum up as to the form of subway and the manner in which the wires are to be placed in it:

I am convinced that from the standpoint of an electrician simply it may be said that almost any plan or system *can be made* to work, from a single lead-covered wire laid directly in the earth to a great tunnel upon whose walls the insulated conductors can be hung. Within certain broad limits, any system is electrically practicable; retardation and induction can be overcome. It is only when we face in this city the mechanical, engineering and chemical question of interference with water-pipes, gas-pipes, and sewer-pipes, of obstructions from vaults, of danger from steam-pipes, of the action of sewer and illuminating gas, that the necessity for careful discrimination presents itself.

In the future, when the uses of electricity become more general and its nature better known, it may be that the City of New York will absolutely require a grand electrical underground highway, where space can be provided for the conducting and distributing of sufficient power to run all the engines and work all the machinery within the city limits. It may be, and probably will be, that before such space is needed, much more will be known of the qualities of different forms of electrical conductors, and of the best methods of carrying them underground, and that the matter of electrical subways will be no longer experimental, but practically demonstrated in every detail. When such a time comes the commission or other authority will determine what is required to meet the necessities of the occasion. The responsibilities of the present commission begin and end with providing for the requirements of their own day, and for such of the exigencies of the future as they can reasonably anticipate. Leaving out of consideration all tunnel systems as too expensive, we must also discard any system which calls for the simple laying of insulated cables in the earth. They would not stand the chemical action of the gases and acids; the streets would be continually torn up for new connections and repairs. We are thus shut up to the question of electric subways or conduits, in which the wires or cables, insulated or otherwise, must be placed, and which once laid down should meet all the demands of the present and near future. Of conduits it may be safely predicated that, so far as the experience of this and other cities is a test, some form or other of a "drawing-in" system is most convenient. The life of the best cable is by no means satisfactorily decided, and, of any particular cable, to predict how long it would last would be purely speculative. Of wires not contained in cables it may be said that they are equally or more uncertain in their length of life and usefulness. At all events, for purposes of distribution it is desirable that the wires should be easily approached at frequent intervals, and the commission cannot countenance any plan that looks to the disturbance of pavements more than is absolutely necessary. It may be that through lines of wire would be better protected laid in permanent beds of insulating material; but a "drawing-in" conduit system allows space to be provided for new wires without the frequent tearing up of pavements. The commission can, therefore, give their approval to a "drawing-in" system with frequent man-holes, as the general form of subway best adapted to meet the requirements of the electrical service of the present.

Passing now to the question of material, I will submit the opinion of a chemical expert whom I have employed to investigate this subject, together with such other opinions as I have been able to gather.

Report of Dr. Albert R. Ledoux, an Expert Chemist, as to the Material for Use in Conduits.

NEW YORK, June 29, 1886.

This problem divides itself naturally, as one examines the papers submitted to the board, into two questions: Shall we use iron conduits, or those which are themselves non-conductors or insulators? I have given this matter the closest attention, and have arrived at the unqualified opinion that a *non-metallic material should be chosen;* not iron—for the following, among many other, reasons:

1st. Expense. Iron pipes or boxes cost more than any of the concrete or cement conduits presented to the commission. A three-inch cast-iron pipe costs about 20 cents a foot, and can possibly be furnished on a very large scale for about 15 cents per foot; while tiling, board boxes, asphaltic mastics, cements and concretes can be made *of the same capacity* for from one-half to one-tenth of this cost.

2d. The next question to cost is that of durability. The experience of all city engineers has proved conclusively that iron under ground is by no means as durable as iron simply exposed to atmospheric influences. Often pipes that have been down some time, although retaining their shape, are found to be eaten through and through with rust, so that the slightest blow shatters them into fragments. Moreover, a very large area of this city under ground is exposed to the action of salt water. In a large number of streets, at a very short distance below the surface of the ground, the tide rises and falls, and in such localities iron is rapidly corroded.

3d. Another objection to iron pipes (electrically) is this: In all the hundreds of miles of cables or single wires which must be strung in the conduits, whatever they may be covered with, there is certain to be more or less leakage of electricity, more or less abrasion and destruction of the insulating covering of the wires. Wherever such takes place within an iron pipe the wire is at once grounded, as is the frequent experience of the telegraph companies now using iron pipes in this city. In addition, should the insulation be weakened upon a conductor carrying the current of an arc electric light, and should this wire thus exposed come in contact with an iron pipe carrying telephone wires, or even telegraph wires, not perfectly insulated, a destructive connection is possible, which might not only injure the smaller wires, but lead into every office or every house where the telephone or telegraph wires entered a current which is at once dangerous to life, and also liable to set fire to the structure.

4th. Again the great expansion and contraction of iron is a disadvantage, when filled with insulated wires; and

5th. Again, the condensation of moisture within an iron conduit, unless a gutta-percha insulation is used, is detrimental.

6th. Again, an iron conduit cannot be sub-divided into separate ducts or chambers for different wires, without rapidly increasing the cost per foot, in a greater degree than when any other material is used.

Discarding iron for the reasons above stated, we have to choose between conduits of wood, cement, tiling, solid asphalt and asphaltic concrete.

The Brooklyn Commission, upon which are two eminent experts, finding that with a well insulated cable any conduit can be made to work, after careful consideration did not choose iron, but first authorized a simple box trench of creosoted wood, and have made no effort to make it either gas or water tight. The result has been, to quote from their last report (see p. 6, 2d Report of Brooklyn Commission) the following:

"In its former report the board mentioned the fact that a conduit of creosoted wood has been successfully operated (with telephone wires alone) in Brooklyn for nine months previously. This conduit has since been opened and examined, and is still in service, thus giving an aggregate test of sixteen months' trial. Nothing was discovered by the examination above mentioned which was unfavorable to the creosoted wood as material for the conduit. But it was found that in some places the lead casing of the cables had been seriously corroded (carbonated) by carbonic acid, probably contained in the 'water gas'—illuminating gas—which had leaked into the conduit. This corrosion would apparently have destroyed the lead casing, at the points where the action was most destructive, in about eighteen months."

In fact, under the influence of dampness and steam heat, such a box becomes in time little else than a blind drain into which will percolate and stagnate more or less of the organic matter of the soil, even if ventilation prevents the accumulation of gas. The experience of the Commercial Cable Company in this city also shows the very strong corrosive action of gas on a lead covering unprotected by an outer impervious shield. The experience with solid conduits is claimed to be satisfactory in Chicago and Washington. When once a wire or cable so bedded becomes imperfect, it must be abandoned and can never be replaced without digging up the whole bed. And no new wires or cables can be introduced when needed without laying a new bed or re-opening the streets, or the owner must insert, once and for all, the whole number of conductors he thinks he may need at any future time, and thus incur a great and unnecessary outlay of capital. The laborer's pick has been one of the great objections to any cement or tiling system, and it is now nowhere seriously considered. To conclude this branch of the subject, after hearing all arguments and careful consideration, I give my unqualified approval to an asphalt concrete conduit, *provided it can be made of sufficient strength and durability, can resist the action of acids, alkalies and gases, and can be made gas and water-tight,* and be in itself an insulator. As I am writing for your personal information and not for the public, I will frankly state that I have been led to this conclusion reluctantly, against my preconceived ideas, and solely by my tests, after consulting the best *disinterested* available authorities in this country. I had, until I began this investigation, the idea that an iron pipe, because now most largely used to hold a simple cable, would, enlarged, be the best form and material for a conduit.

For your guidance I will give here some of the opinions I have obtained:

Mr. R. W. Pope, editor of the *Electrical Engineer*, who appeared before the New York commission at its request, said:

"From an electrical point of view, there can be no doubt that a conduit should be made an insulator. In placing wires inside a conduit of which the material is an insulator, you will have them nearer to the present overhead conditions than in any other way. If iron were used, you would simply bring the wires into closer contact with the earth, which is acknowledged to be a disadvantage. This disadvantage, might, of course, be reduced by a metallic shield, but that would not by any means overcome it. It is an accepted proposition that wires, to be placed under ground, should be well insulated, and being so insulated, it is to their advantage to be placed in a non-conducting material; because if any injury should happen to the insulation of the wires, they would still be protected by the insulating material in the conduit, and so would not come into immediate contact with the earth, as they would if in an iron conduit.

"I speak from many years' study and experience of this question, and am satisfied that whether for wires having metallic shields or for other forms of insulation, a conduit of an insulating material is preferable. I am certainly in favor of such a conduit made of an insulation material."

Mr. J. P. Davis, Vice-President of the Metropolitan Telephone and Telegraph Company, said:

"I indorse what Mr. Pope has stated, that a conduit should be made of an insulating material. When I first gave attention to this matter, I wanted to adopt a glass

tube in cement concrete, but found we could not do it satisfactorily. I have no doubt that, as far as telephone wires are concerned, it would be better to have them in an insulating material.

"There might be raised two objections to this material—the first as to its durability. I have looked into that question very closely for a year, and am perfectly satisfied on that point. Our tests are perfectly satisfactory to us.

"The other is as to the effect of heat upon it, and I have no doubt there is some danger there, but it is a danger that can be guarded against where there is any liability of its coming in contact with steam pipes.

"Further, I don't think the radiation of heat from the pipes is going to be sufficient to cause injury. I think a plank covering would be sufficient."

Mr. R. W. Pope said further: "Wires covered with gutta percha and drawn into the Western Union pipes, which are of iron, are affected by heat. Iron being a conductor of heat, the wires were injured in their insulation. This material being a non-conductor of heat, though it might be affected on its outer surface, would not carry the heat to the wires inside."

Mr. J. P. Davis said: "I have no doubt the material can be protected from steam heat.

"As regards an iron conduit, I had three years' experience with one in Boston. The longest line was about 1,500 feet, and the moment the wires were put into use, the subscribers complained and protested they could not hear. This was caused by retardation. They could not get their voices through. (Probably using the earth as a return circuit, not a metallic circuit. A. R. L.) A greater conductivity in the wires would not remedy this. You could use a much longer line in a conduit that is an insulator than in one that is a conductor.

"No amount of insulating material around the wire could make it work as well in an iron as in an insulated conduit.

"The question of retardation is a very serious one, and the use of iron is undoubtedly a great disadvantage in that respect. The fact is, there is no material that can be put under ground that will resist the dangers to be found there as well as one made from the ingredients used in an asphalt conduit."

In addition to these expert opinions, I have obtained many others, and my own observation leads me to remark:

1st. In a non-conducting conduit the wires of different service are not only protected against grounding, but also against crossing or short circuiting. The very slightest electrical disturbance prohibits almost entirely communication by telephone. De la Rue has shown "that the strength of the electrical current produced by an ordinary telephone in use as a transmitter is less than that which would be generated by a single battery cell through a line of ordinary telegraph wire six million miles in length, and the strongest current produced by such a telephone is only 400-thousandths as strong as that used on a telegraph line; while a current one-millionth as strong as the ordinary telegraph current will give distinct, audible articulation."

This being the fact, you can readily see how important it is that the telephone wire, at least, should be separated not by iron, but by thoroughly insulating material, from stronger currents. The greater question of induction most serious of all electrically in a non-conducting telephone conduit can be, and has been, readily remedied by "anti-induction" cables, metal shields, coupling in metallic circuits, etc., etc., while retardation no device can entirely overcome in wires buried in an iron conduit, even if the sectional area of the conductor is largely increased.

Another advantage in an asphaltic concrete is the readiness with which the shape of a conduit can be altered to suit any locality, the ease of repair and the durability under the conditions of our streets in New York. As to this latter point, I beg to submit the following copy of a report on asphalt concrete, made at the request of the Commissioner of Public Works:

DEPARTMENT OF PUBLIC WORKS, COMMISSIONER'S OFFICE, No. 31 Chambers street,
NEW YORK, Feb. 1, 1886.

To the Commissioner of Public Works:

SIR: The questions you request me to answer are as follows:

First.—The life and probable durability of a cement or concrete structure, principally of compounds of asphaltum, when laid under the streets of New York, subjected to the influences of gases and steam heating pipes.

Second.—Its strength to resist strain.

Third.—The effect of frost.

Fourth.—Its life as compared to cast iron.

To these inquiries I reply in the order of their tabulation, but with the express qualification that the scope and exactness of my answer is limited, owing to the omission of the purpose for which the said "structure" is intended; also that the first question is misleading—doubtless inadvertently so—in that there is no concrete used for structural purposes, so far as I am aware or am able to ascertain, of which the chief component part is "*principally* of compounds of asphaltum," that is, if the term "principally" is meant to express relative mass or bulk. I shall, therefore, assume an intended purpose for the said "structure" analogous to that of drain pipes, sewers or vault work, and also that the material is that usually known to engineers as mastic or asphaltum, and its compounds, concrete. The term "asphaltum and its compounds" has become a somewhat elastic and inclusive term, in that under it are also frequently classed any or all of the residuums of the distillation of petroleum. But, without further amplification, I respectfully submit as follows:

First.—That the life and probable durability of an asphaltum and its components — concrete — "structure" made to best modern specification and patents, is imperishable under the conditions named, as far as my knowledge extends, provided that the heat of steam pipes is not sufficient to melt the structure.

There are but few conditions in practice, however, where this contingency—namely, destruction by heat—could arise, as a properly compounded asphaltum concrete would be acted upon very slowly by radiant heat, certainly requiring at least 212° to render it plastic.

Second.—The strength to resist strain of the best compound asphaltum concretes may be calculated at the following maximums:

Crushing load, 4,000 lbs. per square inch of section.

Tensile strength, 350 lbs. per square inch of section.

This would seem to indicate ample tranverse strength.

Third.—As the best asphaltum concrete is impervious to moisture and is practically incapable of contraction and expansion, frost could, therefore, have no direct or appreciable effect upon it.

Fourth.—As to its life under ground compared to "cast-iron." As matter of fact, *the most widely used and generally successful process of treating iron pipes for underground duty consists in thoroughly coating them with asphaltum.* Without such protection, iron under ground rapidly deteriorates in some cases, much depending, however, on the conditions and locality.

I would add, that the results set forth can only be reached by rigid adherence to details, both in the material and manufacture of the concrete. For instance, I should regard it as essential, among others, that the specification for material and construction should require the use of very sharp sand, thoroughly cleansed and heated to at least 250° before and at the time of mixture; that the bitumen should have the light oils distilled at a high temperature; that the blocks or shells of the structure should be thoroughly tamped during the molding process, and that there should be sufficient compound mastic used to fill all voids or interstices, thereby forming the bond or union to solidify the mass. So formed, so far as disintegration is concerned, there is probably no more durable material used in engineering. Very respectfully,

J. M. BIRDSELL,
Chief Engineer Croton Aqueduct.

EXPERIMENTS.

After arriving at the conclusion that the best material for the conduits is an asphaltic or equivalent concrete, I then determined to make with such a concrete a series of tests to ascertain whether it could be made to stand the ordeal through which a conduit should pass to overcome all the subterranean influences prevalent in the city. A theoretically perfect concrete is one in which the cementing body is in just the proper proportion to exactly fill up, when cold, the interstices in the sand or gravel which forms the base. It should resist the action of sewer and illuminating gas; it should sustain a crushing strain of 4,000 pounds per square inch, so as to support any possible weight when in position; it should be gas and water tight; not attacked by acids; uninjured by salt water; not liable to expansion or contraction; and be able either to stand the heat from steam pipes *in the severest condition* in which it may be necessary to place it, or else be susceptible of being easily and cheaply protected from heat effects that cannot be avoided.

I have had considerable experience with asphalt materials of all kinds, and the proper tests to make easily suggested themselves. I obtained several lengths of such material, and made the following analysis:

ANALYSIS.

The sample contains:

Organic and volatile matter	27.72
Sand and other mineral matter	72.28
	100.00

The organic matter contains:

Oils	5.86 per cent.
Pitch	21.86
	27.72

The mineral matter contains a small amount of metallic oxides.

The following experiments were made:

A sample was placed in a bottle kept at 75°, through which a steady current of street gas was passed for a week; at the end of that time there was not the slightest effect visible. Another sample was suspended in salt water kept at a temperature of 100° F., with no apparent effect. A portion of the conduit was then suspended in water with a thermometer alongside of it and the temperature raised; at 150° it began to soften, but this was upon the outside where in contact with the water. The material is a good non-conductor of heat, and therefore at 150° the effect is only superficial. At 210° the whole mass was soft enough to be indented and pressed out of shape, while heated up to 250° it was disintegrated.

I therefore determined to make another and more thorough heat test; one which would answer the question as to the probable effect of steam pipes in the streets on an asphalt conduit: 1st, as to the effect of the heat under the severest possible test that could approximate to the most rigorous conditions that could be exacted in practice; and, 2d, to see what remedy could be applied, if necessary to lay the conduits near a steam pipe. I therefore had a ditch made in the earth two feet wide, three feet deep and thirty feet in length. In this I laid a 4 inch steam pipe, connected with a pair of 80 horse-power boilers, coupled. The length of pipe from the boilers to the ditch was fifty feet, while a valve upon the further end of the pipe allowed the escape of steam and the outflow of all condensed water. In this ditch I laid three lengths of conduit, as follows: One nine inches from the steam pipe, one six inches, and another three and one-half inches; between the last conduit and the pipe I stood an inch plank, and then filled the trench with sand. Opposite each section, between it and the steam pipe, I inserted self-registering maximum and other standard thermometers; steam was turned on at a pressure of 90 lbs., and a steady pressure was maintained, not going below this point for seven hours. At the end of this time steam was turned off, the conduits examined and the temperature noted. The maxima were as follows:

9 inches from steam pipe	96° F.
6 " " " "	104° F.
3 " " " "	134° F.
1 " " " "	190° F.
2 " " " " but protected by a board	92° F.

You will at once observe that during this length of time at no point was the temperature outside of the pipe high enough to affect the conduit, notwithstanding the fact that the pressure of 90 lbs. in the pipe is equivalent to 324° F. A single inch of intervening earth (sand) was a sufficient protector; while a plank, or coating of mineral wool, would seem all-sufficient for the most extraordinary circumstances imaginable. I must confess that I was surprised at the non-conducting power of the sand [Near the pipe, with no sand between, the temperature was 260°.] I am aware that the presence of moisture, the distance from the surface, etc., would materially affect the radiation and conductivity of the sand, and I, therefore, made the following experiment to prove absolutely the degree of heat: I surrounded the 4-inch pipe with a board casing 18 inches in diameter, through the centre of which passed the pipe. This was filled with sand previously made absolutely dry, and the pressure maintained at 90 lbs. The maximum temperature reached in this box, at a distance of 7 inches from the pipe, was 97° F., during a *six* hours' test. These results, I confess, greatly surprised me, but I give them as I found them. To determine the protection afforded by mineral wool, I wrapped a half-inch iron pipe in a half-inch coating of this material, and inserted it through a 2½-inch conduit duct. Not the slightest effect was produced by steam at a temperature of 290° when passed through this pipe for six hours. I also laid a piece of the concrete upon a bed of mineral wool ¾-inch thick, and allowed the flame of a Bunsen burner to come near the bottom of the mineral wool. The asphalt was not even softened in an hour's time. It is, therefore, absurd to predict any danger from steam-pipes to any such conduit, unless the pipes burst or are in actual contact. In these cases the iron conduits would be equally unsatisfactory, as being such good conductors of heat, the insulation of the conductors would be destroyed.

CONCLUSION.

As to Material.—After a careful examination of the plans submitted to me, and after considering all the facts stated herein, I recommend an asphaltic concrete; but I also recommend the most *rigid testing* and *inspection* of the conduit while being manufactured and laid, and the exacting of guarantees from the manufacturers that their work shall stand certain tests. They should sustain a crushing strength of not less than 4,500 pounds per square inch. It should not soften materially below 160° F. It should be made of the best materials and in the best manner. During the laying a rigid inspection should be maintained.

Insulation.—In a certain sense the commission can afford to be liberal, in allowing the electric companies to use any kind of insulated conductors they prefer, but certain rules should be laid down that will insure the exclusion of untried and experimental compounds, which, should they fail, will cause the frequent reopening of conduits and cause inconvenience and trouble.

With honest inspection and full power to modify any plan adopted, and to make it conform to the exigencies which may arise, I see no trouble in obtaining a speedy compliance with the law, and one that will be satisfactory to all parties and a credit to our city. Many of the plans and devices before the commission will be found of great value when the work of laying the wires commences, and new, and possibly unexpected, problems are presented to your supervising experts. Very respectfully submitted,

ALBERT R. LEDOUX,
M. S., Ph. D.

In addition to the above, I will submit the following report of a general committee of the different electrical companies, furnished and vouched for by President Morton, of Stevens Institute, Hoboken, to the same effect, namely, that insulating materials are preferable for conduit purposes to iron tubes. This conclusion they reached after nearly a year of study and investigation:

THE GENERAL COMMITTEE ON UNDERGROUND COMMUNICATION, 115 Broadway, Room 47,
NEW YORK, March 15, 1884.

To the Committee on Business Organization:

GENTLEMEN: In pursuance of the instructions received by this committee on the seventh day of May, 1883, we beg to report:

About six hundred patents and plans relating to systems of underground electrical communication have been carefully examined.

In the search for a practicable system consideration must first be given to the numerous plans, arrangements or constructions which have for their object the avoidance or elimination of the disturbance due to induction.

* * * * * *

As regards a conduit, the principal requirements are that it be cheap, water-tight, have sufficient capacity, permit (without disturbing the pavement) the insertion, removal and addition of wires, and allow access for repairs and testing.

The material for, and construction of, a conduit are, in a measure, determined by the particular system of conductors it is to carry.

For an inclusive system iron is objectionable. The light conductors require to be widely separated from each other, from all other classes of conductors and from the walls of the conduit. An iron pipe of large diameter would be required, involving great expense. Another objection to iron is that much of the current energy would be uselessly expended in setting up induced currents in the iron pipe. A third objection lies in the difficulty of securing tight joints, due to its large co-efficient of expansion. A fourth pertains to its destructibility.

Various other materials have been suggested for an underground conduit—wood creosoted or coated with paraffine or asphalt, glass, porcelain, earthenware coated with asphalt, stoneware, artificial stone, glazed terra-cotta, asphalt-coated terra-cotta, paper saturated with asphalt, and various compositions, such as marble dust and asphalt; sand, linseed oil and asphalt; sand, broken stone and asphalt; sulphur, sesquioxide of iron and bitumen; sand, paraffine, asphalt, with the addition of certain chemicals, etc., etc.

As far as durability is concerned, wood, properly treated, is known to last underground a great many years and could be used in the construction of a conduit. Creosoted wood is, however, injurious to gutta-percha-covered wires. Earthenware or terra-cotta pipes have been used in England, and if glazed or coated with asphalt, and well-jointed to exclude moisture, could be used for underground service. Glass and porcelain are expensive materials. Asphalt-saturated paper could be used for the lining of passages in some forms of underground conduit. Artificial stone molded into a continuous conduit is cheap, and one of this kind was laid in 1881 in Market street, Philadelphia. In this conduit tin tubes covered with asphalt are imbedded in the artificial stone.

Terra-cotta thoroughly coated with asphalt is a cheap material, and when protected by an outer box or covering of creosoted wood is adapted for an underground conduit of the usual form. It is unaffected by changes of temperature, there is little or no difficulty in securing and maintaining tight joints, and if properly coated with asphaltum it is indestructible. As regards the compositions before referred to, the last named, consisting of asphalt, sand, paraffine, etc., is stated to be a good insulator and impervious to moisture, as well as strong and durable.

Respectfully submitted,
Sub-Committee on Electrical and Mechanical Devices,
By HENRY MORTON, Chairman,
WILLIAM C. BEHRENS, Secretary.

In addition I will submit the report of Mr. John Thomp-

son, the commission's expert, in reference to the material to be used in conduits.

Fifth.—*Special Observations with Respect to Material.* Electrically considered, the first pair of propositions which present themselves are: Shall we endeavor to place the electric conductors in the most intimate contact with earth; or contrariwise, shall we simulate so far as practicable the existing conditions above the surface? Upon this subject there seems to be as wide a difference of opinion between the doctors of electricity as the doctors of medicine.

Shall it be *contraria* or *similia*? Under each phantom subjects have died and have recovered.

If this question devolved upon the possibility, can the electric conductors under any circumstances be made to work, then there would be no controversy, for certainly they can. But in that it is apprehended the question is: How best will they operate? The answer unhesitatingly is given that an insulated conduit is best calculated to give general satisfaction, and for the following reasons among others:

Asphaltum concrete is a good non-conductor of electricity. It has practically no co-efficient of expansion. It is a good non-conductor of heat and very slowly acted upon thereby. It is cheap to manufacture. Strong, elastic, durable and generally adapted for the purpose. Hence, the wires or cables would not require to be so heavily insulated or widely separated, nor would there be liability to admit gas or moisture due to separation of joints by expansion or contraction. In the instance of the telephone wires, as affected by retardation, it offers the one fundamental remedy known for this most serious difficulty, namely, separation from earth.

Iron is an excellent conductor of electricity. It has a high co-efficient of expansion. It is an excellent conductor of heat. It, therefore, would only afford mechanical protection to the wires or cables, and in view of the area of ground contact afforded each wire or cable would thereby be brought into far more intimate electrical relations with earth than if each of said wires or cables were separately buried therein. This has been presented as an advantage in that induced currents would thereby be dissipated. But it is apprehended that this would tend to set up induced currents where they would otherwise not exist, and, therefore, be simply a useless waste of energy, and to that extent *increasing* the nominal retarding effect due to earth contact.

Nor has it been seriously proposed to attempt to form continuous ducts in an iron conduit without break. Such is impracticable unless a separate pipe be laid for each cable. And as it has been demonstrated in practice that but one cable can be advantageously handled in each duct, this fault is, in itself, a serious objection.

In support of this view of the case a few authorities and illustrations may be cited. The Joint Committee on Underground Communication reported on December 5, 1883, that "for an inclusive system, iron is objectionable." The underground cables of Germany are laid in a trench filled with bitumen. The underground wires of England are bunched in iron pipes; but it has been reported the telephone service so attempted has not been successful. The Bell Telephone Company put cables through iron pipes in Boston; but their engineer, Mr. Davis, has stated before this board that the retardation was so great as to cause serious dissatisfaction among their patrons, though the extent of buried wires was limited. Mr. Frank L. Pope, the electrical expert, indorsed a system presented to you, consisting of heavy glass tubes incased with iron. Mr. Ralph W. Pope, editor of the *Electrical Engineer*, testified before you his preference for an insulated conduit. The cables laid about a year ago in Brooklyn, in a comparatively open ditch, formed by creosoted wood, have already proved to an extent unworthy, and concrete conduits are now being laid. As opposed to this, but one prominent authority has taken a contending view before you, namely, Mr. T. A. Edison, who asserts that any or all wires can be made to operate successfully even when bunched promiscuously in one common iron pipe. So being, then so much the better. But while experience is not infallible as a guide to truth, it is yet fair to submit whether or no it would be wise or expedient for you to take the initiative in the adoption of a scheme generally opposed by experienced authority. As to the term "asphaltum concrete," it is of elastic proportions, and may require to be defined. In the estimate of the writer but two elements are of controlling importance, namely, honest material and honest workmanship. The bitumen ought to be distilled at a moderately high temperature, sufficient to drive off the lighter oils, and yet not great enough to char or burn the residuum. The sand (siliceous) should be perfectly clean, very sharp, of small grain, and heated to at least 220° before and at the time of mixture. These simple elements, first thoroughly commingled, and then tamped during the molding process, form a mass than which there is probably none more durable known to engineering, impervious alike to moisture, gases and acids.

As to the strength of this structure: Much consideration has been given to this aspect of the case, in view of the proximity to the street surface, in which it is desired to lay the conduit. From the data on this subject, it is safe to say that asphaltum concrete can be uniformly produced offering a minimum crushing resistance equal to 4,500 pounds per square inch and an ultimate tensile strength equal to 325 pounds per square inch of section. This would indicate ample transverse strength, particularly when it is considered that the top and bottom of the conduits are proposed to be reinforced by concrete, so that the entire mass would virtually be a monolith extending from junction-box to junction-box. It may be stated that asphaltum concrete, in consequence of its resilient property, has been used with complete satisfaction as a foundation for steam and drop hammers, and analogous situations subjected to heavy and continued impacts.

Sixth—Respecting patents: This aspect of the problem has been regarded with considerable apprehension; for it may be considered as practically certain that, whatever be the system put down, patent litigation will be likely to follow. This opinion is based upon the fact that while underground systems for conveying electric conductors are comparatively new, there has yet been a very considerable number of patents granted thereon, covering a wide range of plans, processes and manufacturing appliances. Nevertheless, "the state of the art," and the validity of what may be regarded as generic patents, have not yet been defined by the courts. No attempt has been made to act upon this subject, as, were it properly passed upon, it would require an extended and painstaking search, involving considerable expense, and, at the best, the result thereof would be but an opinion, with which the courts after all might not agree. And yet this is a feature of great importance which may not be disregarded.

Seventh and finally—A few suggestions as to supervision and rules would seem to be in order:

1. The company who may build the conduit should at once prepare and submit a working plan of such section of the city as you may select for immediate operations.

2. The survey should give the exact condition of the street or streets, and the number and kind of conductors in use.

3. All matters of detail, either as pertains to the conduit, the entrenchment, or the management thereof, to be subject to your approval.

4. It should be provided that no cable be drawn into the conduit of greater length or diameter than would enable the conduit company to handle it easily.

5. All wires entering the conduit from sources above ground should be provided with approved lightning arresters to prevent damages to their insulation by atmospheric electricity.

6. The conduit company should have absolute control of all running wires, repairs, connections, changes of every kind and character, thus enabling them to keep track, by means of maps and otherwise, of the locations and positions of all wires, branch connections, etc., etc., and thus prevent and be responsible for any interference between competitive companies.

7. The conduit company should be responsible for all damages done to cables of the different companies by reason of their neglect or other work.

8. As to any or all patents owned or controlled by the conduit company, as well as any or all patents not owned by said company, it should assume all risks of possible patent interference and litigation, as against the city, the electric companies and the commission, and should file a bond of indemnity sufficient to assure such risk.

9. The commission ought also to reserve the right to make such modifications and changes as may occur in the future due to the experience acquired in the accomplishment of the work and more extended and mature deliberation.

The foregoing is respectfully submitted and subscribed to as representing the most advanced principles, as proved in the judgment of the writer by preponderance of evidence and opinion.

While it appears, therefore:

1st. That any kind of conduit which will protect the insulated wires will answer, and on the other hand,

2d. That no known conduit has yet been found which works perfectly, or is an ideal one. It may be said with confidence that the weight of evidence before the commission is toward the use of an insulating material for conduits, and of insulating materials asphalt or bituminous concrete has certain advantage over all others, viz.:

1st. It is cheap.
2d. It is durable.
3d. It is capable of standing harsh treatment.
4th. It can be easily and closely jointed.
5th. It can be made absolutely free from moisture, and free from contraction and expansion.
6th. It is a bad conductor of heat as well as of electricity.

Finally, in using asphalt or bituminous concretes for the main material of the subway, the commission can also provide metallic induction shields or special insulation for such companies as desire, and may readily make ducts conformable to special exigencies, while preserving the principle of extra insulation in the material of the conduit intact. A conduit is nothing more electrically and mechanically than a protection for the wires within it, and a convenience for placing them under ground.

It is the part of the commission to secure to the best of their information and belief the best and most convenient protection for the wires, and it is believed that this can be secured in an asphalt concrete "drawing-in and out" conduit, and that in the material decided upon all the advantages known to exist in any system can be successfully combined.

But in the same way as it has been said that for particular purposes or particular localities, it may be necessary for the commission to depart from the drawing-in system, so it may be said that it may be necessary for them at times to depart from the asphalt concrete material.

Iron pipes have two distinct advantages over the asphalt concrete which are indisputable. They are stronger and they are less bulky. If for special reasons extrordinary strength or compactness is preferable at special points to durability and insulating properties and cheapness, then the commission can at those points be compelled to modify their plan to suit the exigencies of the case and use iron.

Again, there are cases where it would be foolishness for the commission not to take advantage of certain circumstances which render a modification of their plan reasonable, as for instance where cable surface roads or underground roads are in process of construction, and where for an outlay much less than that required to lay any kind of conduit, the commission can secure a space admirably adapted to their wants.

In general we may conclude that while we approve *the asphalt concrete drawing-in system*, other things being equal, each particular specification of the commission will have to be governed by the circumstances of the case for which it provides.

The following resolution was then adopted by the commission:

Resolved, That the commission, in view of all the information they have been able to acquire on the subject, favor a subway which shall in the main conform to the following requirements:

(1) Its material shall be an asphalt or bituminous concrete, which shall be capable of sustaining the following tests: Strength—It should sustain a crushing test of 4,000 pounds per square inch, and have a tensile strength of not less than 300 pounds per square inch of section. Resistance to heat and cold—It should not crack when subjected to a temperature of 10°, nor lose its shape at 200°. It should not soften below 160°. Other physical properties—It should resist the action of organic acids and illuminating gas, and should not disintegrate under the action of salt water. Materials—The pitch or asphalt used should be inspected before it enters into the concrete, and be pliable at 150°, but brittle below that temperature. It should not be heated above 325° in boiling. The sand used should be silicious, and the porosity of each lot carefully determined, so as to insure the perfect cohesion of the mass, with no excess of plastic material. But this shall not prevent the use of any other material where the special exigencies of particular electrical service or of particular localities render it advisable in the opinion of the commission.

(2) Its form shall in general be that of a conduit with convenient man-holes where cables and insulated wires may be readily drawn in and out of distinct ducts in the conduit; but this shall not prevent the laying of wires in other ways where for special reasons it may seem desirable to the commission.

The following was also adopted:

Whereas, The commission have no funds, and there are no means at present existing by which such funds can be raised by the commission, and whereas it is important that the placing of wires under ground shall begin at the earliest moment possible, and whereas, the commission are advised by the Attorney-General of the State that they may properly engage with a construction company for the performance of this work;

Resolved, That the counsel of the commission be called upon to report at the next meeting of the commission generally as to a company to lay, operate and maintain the subway under the direction and control of the commission, and to suggest to the commission all necessary legal precautions and safeguards in the government of such company, with a general plan of contract to be made by the commission with such company, which plan, before it is adopted by the commission in any form, shall be submitted to the Attorney-General for his official criticism.

Austrian-American Cored Carbons.

Electric light managers and electricians familiar with arc lamps are generally well acquainted with the qualities of imported "Austrian cored carbons." These "points" have gained considerable reputation in the American market, but an obstacle in the way of their widespread adoption has been the high price. The Forest City Carbon Manufacturing Company, of Cleveland, O. (Holmes, Booth & Haydens, sole agents), is producing, however, a cored carbon, said to be equal in every respect to the imported article, and at prices about two-thirds lower. The company saw its way clear last February to the manufacture of this carbon, and at great expense immediately put in the requisite new machinery, with the result that it is now busily engaged meeting an active demand. The great merit of these carbons lies in their low resistance, whereby more candle-power is obtained to the horse-power. The arc does not travel around the carbon, but is kept in a well-defined central crater, formed by the consumption of the core. The light burns steadily and uniformly, without flickering or unevenness.

The carbons undergo special treatment, being first formed with a hole throughout and then baked. The soft material, the preparation of which constitutes, we believe, a close trade secret, is then introduced to form the core, and the whole is subjected to further careful preparation before it is ready for use. Some severe tests have been made with the carbons on different systems in various parts of the country, with satisfactory result; and although the article has only been on the market a few weeks, it appears to be warmly appreciated. One recent order from the Thomson-Houston Company of Chicago, is for 25,000.

The Lowell Syndicate Investigation.

At Lowell, on July 3, in the suit of William H. Bent *vs.* the Erie Telephone Company, Mr. Charles J. Glidden produced the certificate book of the National Bell Telephone Company to prove that certificates were issued in the Bent pool in January, 1883. Of the $17,000,000 capital stock of the New England and Erie companies, only $15,000,000 have been issued. A letter from Mr. Bent was then admitted as evidence, showing it was the intention to keep the Northwestern Company alive, notwithstanding the consolidation with the Erie Company. Mr. Bent must have known of the purchase of the Dakota Company, as it was entered on the pool books, which were open at all times to interested parties. As treasurer of the Northwestern pool, he had paid $150,000 at the Prescott National Bank for this property. He could not understand how it came into Mr. Coburn's possession, or why he should retain it.

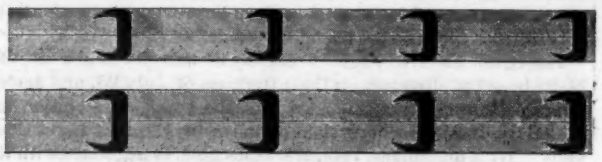
Testimony was next given regarding the formation of a pool to bolster up the Erie Company stock. Notwithstanding this effort and the investment of $50,000, the price went down in the market.

Mr. Glidden said Messrs. Ingham and Bent suggested to him that the books of the National Bell Company, of Maine, be manipulated to cover the deficiency of $23,000; witness thought the books had been changed for that purpose, but they are now correct. Mr. Glidden said he was present at the meeting of the Erie Company in June, 1883, in Lowell. A minority vote of 808 votes against 1,300 prevailed. There was a protest against such action. The salary question was also discussed at that meeting; Mr. Bent was of the opinion that the officers had served long enough without salary. When closely pressed, Mr. Glidden finally said he did tell some person that Mr. Ingham employed counsel to keep him out of Sing Sing. He should not think it had any derogatory effect upon the character of Messrs. Ingham or Bent. Mr. Ingham received a salary of $6,000 and witness $4,000. Mr. Ingham divided his salary nearly all the time of their connection in the New England Company, so that each received $5,000. Both were pooling their issues at that time, but not on the Sing Sing question. Adjournment was made to Tuesday, Oct. 5.

The Transmission of Power to Dynamos.

Very much of the unsatisfactory result often experienced in running dynamos is directly traceable to the use of improper belting. It has long since been learned that to secure the most economical and uniform results dynamos of the best construction must be employed, and then these must be driven by engines especially adapted to the purpose. But, where these conditions exist, and the connection between the two is made by an improper belt, the result sought for can never be attained; on the contrary, we have an unsteady light that is produced at a large expense. Hence the demand for a belt made with special reference to this kind of work.

If a leather belt, it should be made from leather selected with very great care from the choicest young steer hides



WIRE-SEWN BELTING FOR DYNAMOS.

taken from fat creatures. The fibres of such hides are uniformly strong; and they are rich in gelatine, so that a firm, strong belt is the result. But even of such hides as these only a small portion is suitable for the purpose.

If the belt is single it should be very heavy, and as nearly balanced as possible. But it is said to be always better to use a double belt, provided it is suitably fastened so as not to come apart, because the belt will run steadier and be more perfectly balanced than a single belt. A double dynamo belt should not be very heavy, but the quality of the leather should be the same as in the single dynamo belt. It should be a waterproof belt, so that it shall not be affected by atmospheric changes.

A very important feature in such a belt is the proper fastening of the laps where it is single and the edges where it is double. Running at such a high rate of speed, it is very apt to come apart as it passes over the small pulley, which is usually made very crowning in the centre.

The Page Belting Company, of Concord, N. H., manufactures an article intended to meet exactly the wants of all who run electric dynamos. Copper rivets, it maintains, should never be used, as they present a large metal surface to come in contact with the pulley, and it is not practicable to put them near enough together to hold the joints and plies securely. Wax threads and lace sewing do not leave the belt with a perfectly smooth surface; hence these are objectionable, and it is not safe to depend upon the cement alone. It has given its own belt the appropriate name of "dynamo." The belt is made from just such leather as we have described; every belt is "waterproofed," and, in addition to very careful cementing, it is fastened by copper wire sewing—the laps of the single once in ¼ inch along the edge, and the double once in ¾ inch. This wire sewing is really a secure clinch made by a square copper wire, pointed very sharp at both ends, and thoroughly clinched down on both sides, as shown in the accompanying cuts.

By this means the surfaces of the belts are left perfectly smooth, and the clinch makes a thoroughly secure fastener. Every belt is carefully tested in the factory before it is sent out, and every one is thoroughly warranted.

Differences between Positive and Negative Electricity.

Dr. Wachter, of Vienna, has recently communicated to the Academy of Science in that city a paper, in which he attempts to prove that, contrary to the generally accepted belief, crediting positive and negative electricity with absolutely analogous properties differing only in sign, there are between them many points of diversity. He maintains that the properties of the two electricities are totally different, and these differences manifest themselves in regard to (1) equipotential surfaces, (2) direction of movement, (3) magnetic, (4) thermic, and (5) optic properties; also (6) in regard to the substances electrified. Dr. Wachter treats only of the first and second headings. He asserts that in conductors of great specific resistance the point where the potential has a mean value lies, not midway between the extreme ends of the conductor, but somewhat nearer the negative end. If equal quantities of positive and negative electricity accumulate respectively on two conductors of equal size, the potential, measured by means of an electrometer, has a greater value, irrespective of the sign, on the positive than on the negative conductor. The electric mill revolves in the direction of the flow of positive electricity, which proves that the movement of the molecules of air around a positive and negative point is different. The appearance of the discharge from such points is also different, indicating an inequality in the equipotential surfaces.

Some Novel Forms of Mechanical or "Vibrating" Telephones.

Mechanical telephony continues to absorb the attention of inventors, and recently some novel forms have been devised. The vibrating diaphragm has been entirely dispensed with, and in its place a vibrating spring has been substituted. This is shown in Fig. 1. The line is attached, a tubular connection is made to the end of it, as shown in Fig. 2, and the arrangement, which has been devised by Mr. Hugh Lamont, of Blissfield, Mich., is said to make an excellent receiver. Another method of accomplishing the same result is shown in Fig. 3, in which the diaphragm is merely hung loosely upon the hook of the vibrating spring, there being no tension whatever on the diaphragm.

Mr. Lamont and Mr. Wm. Hubbard, of Elgin, Ill., have combined, under the name of the American Molecular Telephone Company, and have adopted the form of telephone shown in perspective in Fig. 5 and in section in Fig. 4. The

FIG. 3.—"VIBRATE BAR" TELEPHONE.

tension here does not come directly upon the diaphragm, but upon a steel band across the front of the diaphragm, though not directly upon the vibrating-bar, as in the former case. This arrangement is understood to yield excellent results, and is claimed to have worked satisfactorily over a line 4 miles in length.

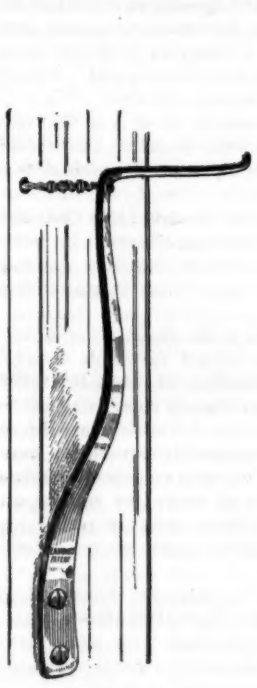


FIG. 1.

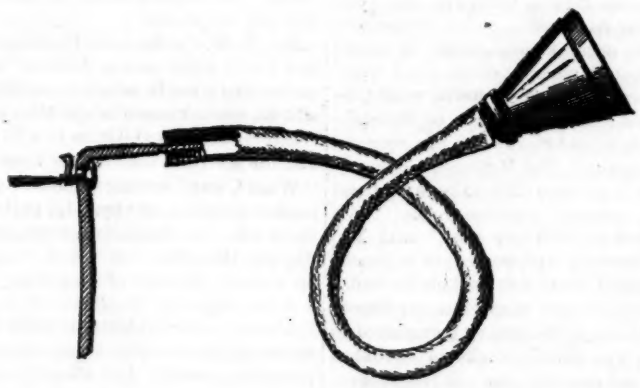


FIG. 2.

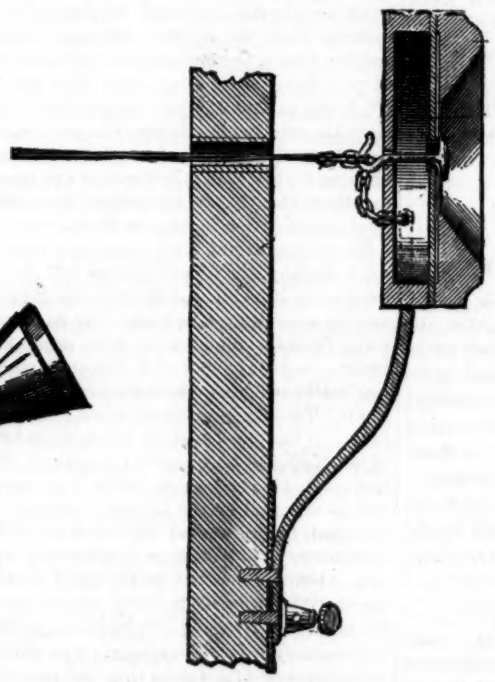


FIG. 4.

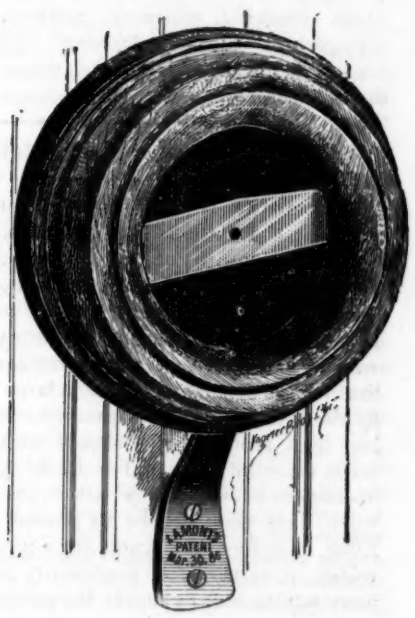


FIG. 5.

NEW FORMS OF MECHANICAL TELEPHONES.

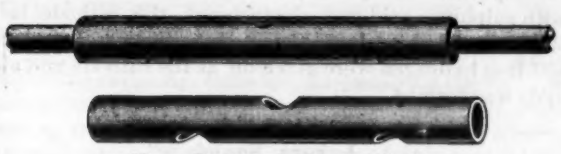
The use of a diaphragm of wood or paper pulp sheets has been patented also, and the material is said to answer admirably for the purpose.

The gentlemen named invite correspondence with regard to the introduction of their system, which they think to be specially applicable to lines of considerable length. About 40 lines are now in operation in Michigan alone.

One line, in good operation, runs six miles, from Blissfield to Lenawee Junction. Patents have been secured in Great Britain.

Tubular Connector for Making Wire Joints or Splices.

We illustrate herewith a new connector for making joints in electric wires and cables. It is adapted to con-



NEW CONNECTOR FOR WIRES.

ductors of all sizes, and possesses features which combined make it one of the neatest connectors we have yet seen. It is manufactured by, and is the invention of Mr. Forée Bain, electrical engineer, of Chicago. It is simple; being in only one piece, there are no parts to lose. It makes as strong a joint as a solid wire. The fall of potential at the joint when this connector is used, is not greater than in the same length of the solid wire, so that joints of this kind are not objectionable as regards increased resistance, as is the case when the old twist joint is used. Hence scrap wire and short pieces can be used in lines. The saving of wire over the quantity required to make the old twisted joint will more than pay for this connector, to say nothing of the difference in time required to do the work. The joint is light—not bulky or clumsy—and when nicely covered with tape can hardly be noticed in the line. It is well adapted to out-door use. There are no air spaces in it, and consequently there is no corrosion, condensation or collection of moisture, and no chemical or electrolytic action, which is the cause of the great increase of resistance in old twist joints, or when a temporary connector is used.

This connector possesses the additional feature of being low priced. It is kept in stock for wires from No. 0000 to No. 16 Brown & Sharpe gauge. It is very useful for large leads in incandescent wiring. The device will be found equally valuable in wiring arc light circuits, as well as for telegraph, telephone, fire alarm, etc.

There are no special tools required for making the joint; an ordinary soldering copper, a hot iron, or a lamp will do the work nicely.

The operation is performed in the following manner: Clean the ends of the wires or cables, and slip them into the tube until their ends meet at the middle hole in the tube, then hold a little solder over this hole and apply heat; or a small piece of solder may be cut off and laid over the hole. As soon as the tube becomes sufficiently warm, the solder will melt and run into the tube and around the wires, then filling the tube and completely and thoroughly "sweating" the wires together. If it should be desired to braze a joint, spelter and borax are used instead of solder and acid, with a blow pipe and an alcohol lamp. Silver or hard solder joints may be made in a similar manner with this connector. In making a soft solder joint, resin or acid may be used. There is no objection to the use of acid. Mr. Bain invites every electrician to send for samples and if they are purchasers to ask for prices.

Electrolysis of Some Chemical Compounds.

M. D. Tommasi, according to an abstract in the Journal of the Chemical Society, maintains that if an aqueous solution of potassium chlorate acidified with sulphuric acid so diluted that when treated with metallic zinc no reduction of the chlorate takes place is submitted to electrolysis, the anode being formed of pure zinc, reduction occurs and potassium chloride is formed, although if the electrolysis is conducted with platinum electrodes no such action takes place. The reduction is therefore due to the direct union of the zinc with the oxygen of the chlorate, and not to the action of nascent hydrogen. Potassium perchlorate is not reduced by electrolysis even when a zinc electrode is employed. A dilute aqueous solution of chloral hydrate in a porous cell placed in a vessel of water acidified with sulphuric acid was electrolyzed, the cathode being placed in the chloral and the anode in the water; chlorine and free hydrogen were given off at the cathode and aldehyde was formed.

Aurora Sounds.

In March, 1885, Sophus Tromholt dispatched some thousand circulars to all parts of Norway containing different queries regarding the aurora, and among them also the following: "Have you or your acquaintances ever heard any sound during aurora, and, in this case, when and in what manner?" Up to Sept. 16, he had received answers to these queries from 144 persons. Of these, not less than ninety-two, or sixty-four per cent., believe in the existence of the aurora sound, and fifty-three (thirty-six per cent.) state that they have heard it themselves, while the other thirty-nine cite testimonials from other people; only twenty-one (fifteen per cent.) declare that they have never heard the sound and know nothing about it, and the other thirty-one (twenty-two per cent.) have not noticed the query at all. There are thus ninety-two affirmations against twenty-one negations. The sound is variously described in these answers as sizzling, creaking, whizzing, rustling, crackling, hissing, whispering, rushing, buzzing, rippling, roaring, din, breezy, whipping, fanning, clashing, flapping, sweeping, etc.—*Nature.*

Dermatine Insulation.

A company is in course of formation in England to work the patents of Mr. Maximilian Zingler for the manufacture of dermatine, a substance said to be a substitue for gutta percha, India rubber and leather. The prospectus states that "insulated telegraph wires for underground work have been covered with it, and the results obtained warrant the anticipation that in this department alone a large business will be done by the company. The capacity of the material for standing high temperatures should make dermatine-covered wires especially safe and desirable for electric light leads. Specimens of wire, of a pattern suitable for underground work, have been proved to possess an insulation of over 1,000 megohms per knot after prolonged immersion in water; it is therefore confidently believed that the company will be able to supply the public an equally efficient and far more durable insulated wire than any now in the market, and the prices being lower than those charged for India-rubber or gutta-percha. It is expected that dermatine will, to a very great extent, eventually supersede the materials now used for this and many other electrical purposes."

Grenet Batteries in Incandescent Lighting.

To the Editor of The Electrical World:

SIR: (1.) Can you tell me how many 8-inch American form Grenet cells would be required to light one 1 c.-p. Edison lamp? Also (2) how many would be required for one 6 c.-p. Edison incandescent lamp? D. C. G.

FRANKLIN, Ga.

ANSWER.—(1.) About 3. (2.) From 12 to 15.—EDS. E. W.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, July 6, 1886.

The Vitrite & Luminoid Company, 14 Dey street, are the agents for the Electric Manufacturing Company of Troy, N. Y., who have greatly increased their facilities by the erection of their fine new brick factory at Greenbush, N. Y. The standard set of resistances used at Greenbush was adjusted at Johns Hopkins University by Lieutenant Duncan, U. S. N., and altogether the utmost care is exercised to produce fine reliable instruments. The Vitrite Company are doing very nicely with their incandescent lamp.

The Continental Conduit Company have an experimental department at 515 West Forty-second street, where I had the pleasure the other day of examining the new plaster section lately put up for exhibition, and made under the patents of the Beere-Grant system for subways and conduits for electrical conductors. The section shown is a very ingenious piece of architecture, if I may use that word. As the system has been illustrated in THE ELECTRICAL WORLD, I need not go into details. At the bottom of the conduit is a division devoted to electric light wires and cables. Other divisions belong to telegraph and telephone wires, and all the various services, and, knowing something of mechanical contrivances, I must say that the devices and arrangements for getting at wires—the fundamental and vital principle in any underground system—are all that could be desired. Concretes are used for the conduits. The system is worthy of careful inspection in these days when the wires "must go." Mr. Eugene W. Austin is president of the company, and Mr. John D. Beere is secretary. The offices are at 115 Broadway.

The National Electric Service Company is enjoying a liberal patronage of its system for rendering our offices and houses healthy and comfortable. Among those who have been putting in the apparatus for regulating temperature, etc., are: The Boston, Mass., Hospital; and a life insurance company building for $4,000; residence of S. Nickerson, Chicago, $1,200; residence H. H. Porter, Chicago, $800; residence F. McVeagh, Chicago; residence J. L. Bostwick, corner 61st street and Fifth avenue, New York city; Elliott F. Shepard, Vanderbilt mansion, Fifth avenue; residence and stables H. L. Horton, 144 West 57th street; Queen's Insurance Company, 37 Wall street; Commercial National Bank; residence Whitelaw Reid; residence E. H. Johnson, president of the Edison Company; residence Mrs. Mary Mapes Dodge, editor of *St. Nicholas*, Dove Apartment house; residence J. S. Rockwell, East Orange, N. J.; reception room of the Committee on Pensions, Washington, D. C.; residence, John F. Anderson, Jr., Brooklyn; residence, Thomas A. Edison, Llewellyn Park, N. J. I notice, too, that Quartermaster General M. C. Meigs is getting great credit for his ingenuity in suspending a thermostat from the ceiling in the main hall of the Pension Building, to indicate to the engineer, by the ringing of a bell, the temperature of that place, so that it can be regulated. This thermostat was furnished by the National Electric Service Company. In almost all the above places what is known as the complete service has been put in. Several other places are now being equipped. The offices of the company are at 686 Broadway. It seems to me that this application of electricity is one that electricians in every part of the country can create a demand for, and by so doing, benefit themselves.

William H. Broadnax, a printer doing business in this city and residing in Brooklyn, has been arrested in a civil action which involves a criminal charge of forgery. Dr. Alexander Lewis, of Montague street, Brooklyn, the plaintiff, lent Broadnax about $7,500, receiving as security paper representing bonds of the Consolidated Electric Light Company for $46,000. As the interest became due quarterly Broadnax paid it and redeemed the coupons from the doctor. He failed to call on July 1, however, and Dr. Lewis, having business, called at the office of the company. It was then discovered that the bonds were forgeries. Dr. Lewis explained where he got them. Broadnax had the contract for printing the bonds for the company. When arrested Broadnax admitted that he had floated the spurious bonds, explaining that he was in difficulties and thought he would be able to redeem them before the forgery was discovered. Dr. Lewis has commenced action to recover $6,985 from Broadnax.

Supplementary of what I said in my last notes about the Edison Company, the following item will be of interest: Since the settlement of its labor difficulties the Edison Company has been looking around for a new place for its machine shops, somewhere away from the influence of labor organizations, where it might build up a little colony of workmen in whom it could place absolute confidence, and where the probability of a strike would be small. The company thinks it has found this place in Schenectady. It has purchased ten acres of land there from the receiver of the McQueen Locomotive Company. The McQueen Company had erected two big shops before it got into difficulties, and these will be occupied by the Edison Company's machine works. "We intended, before we had this trouble with our men," said Mr. Batchelor, "to erect shops on a block of land we bought in Brooklyn. Architect Post had all the plans ready and the bids for building the shops were all in. Now we will have to sacrifice our Brooklyn land. We probably will have all our machinery transferred to Schenectady before the winter. The casting works in Brooklyn will be operated for a short time, and then that also will be removed. Probably between 700 and 1,000 men will be employed in the Schenectady works. We expect to pay less money for labor there, as living is cheaper. Our men now get from $2 00 to $3.25. The wages we will pay in Schenectady will be from $1.60 to $2.25, and we have no doubt that we can get all the workmen we need at those rates. We will have the new works in Schenectady running inside of six weeks."

Mr. Clark B. Hotchkiss has just supplied the Western Union Company with some new kerite cables for this city, replacing others that were imported and have failed. Mr. Hotchkiss is not a little proud of the excellence of his work, and he well may be. If you drop into his new offices in Dey street, he can take you to the windows and show you there, running by, overhead, some Gold & Stock kerite cables that have been up for thirteen years and are to-day in efficient service, in spite of weather, rough handling, the strain of heavy currents, and much shifting around from place to place. In years now remote I expect, while perambulating the electrical subways of New York, to recognize those same old cables, still true to their "tickers." W. T. H.

SARATOGA SPRINGS, N. Y., June 29, 1886.

The Saratoga Gas Company purchased of the Jenney Electric Company, of Indianapolis, an eighty-light plant for the lighting of the streets, hotels and stores of this city. The installation was completed during the past week, and has certainly fulfilled the very high expectations of the purchasers. The benefits of the recent improvements of Mr. Jenney are clearly manifested in the thoroughly satisfactory performance of his system. The notable points about the light are its superior steadiness and brilliancy. The purchasing company made this choice after a very thorough canvass of all other systems, and were guided solely by a desire to purchase the best. It is the unanimous opinion of our citizens that their selection was a happy one.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Mass., July 5, 1886.

Major John B. Powell, general manager of the Brush-Swan Electric Light Company, was in this city during the past week on a business visit.

The Sprague Electric Power Company has installed one of its machines in the office of the Brush Electric Light Company, and arrangements have been effected with the latter named company for the use of its arc-circuits wherever they may be required for the transmission of power.

The police patrol signaling system recently installed in South Boston by the Municipal Signal Company continues to work in a satisfactory manner. It has been inspected by the police authorities of numerous cities, with a view to its introduction. The company held its annual meeting last week and elected officers as follows: John C. Wilson, president; Charles N. Barnard, treasurer; George W. Gregory, John C. Wilson, Charles N. Barnard, Albert A. Pope, Willard White, Thomas Roche and E. Hyde Rust, directors.

Col. Silas Gurney, president of the Merchants' Electric Light and Power Company, is about to introduce incandescent lighting into the popular hotel of which he is the proprietor—the Tremont House. He has recently expended a large sum of money in remodeling and refurnishing his hotel throughout; and to-day it stands unsurpassed in point of modern improvements, and all the accessories so dear to the traveling public.

The Brush Electric Light Company of this city held a meeting of its board of directors on the afternoon of July 2d, and among the important matters discussed was the proposed adoption and use of the incandescent system of the Sun Electric Light Company. By a unanimous vote, it was decided to negotiate with the latter company for the use of its distributing boxes and lamps in incandescent lighting off the arc-light circuits of the former.

For several weeks the Brush Company has been successfully using the system referred to on a number of its arc light circuits, and so highly satisfactory have been the results attained that the company readily joins hands with the Woburn enterprise in the introduction of a new and meritorious system of incandescent lighting.

The Waltham, Mass., Electric Lighting Company has been incorporated with a capital of $20,000. The officers are as follows: President, Chas. C. Bills; treasurer, Elliot A. Harrington; directors, Henry N. Fisher, Alfred M. Goodale, William Roberts, Charles E. Getchell, Chas. C. Bills and Elliot A. Harrington.

The Malden, Mass., Electric Light and Power Company began operations on the evening of the 1st instant. At present about 30 arc-lights of the Thomson-Houston system are in use, with orders already in hand for additional lights.

Since the introduction of an electric fire-alarm system in the shoe factories at Beverly, Mass., the insurance companies have notified the factory proprietors that a reduction of 30 cents per $100 on their insurance will be allowed on this account. This reduction is to apply only on new policies and renewals.

The Salem, Mass., aldermen, at a special meeting of the board on July 2, passed a $2,000 appropriation to defray the expenses of the electric lights the remainder of the year, the number to be increased to one hundred.

At Middletown, Conn., the Schuyler Electric Light Company, at a recent meeting, elected the following officers: President, D. Ward Northrop; Treasurer and General Manager, James P. Stow. The capital stock of the company was increased from $35,000 to $45,000.

Mr. E. M. Carhart, of Providence, is the inventor of a novel and useful water motor, destined to attract favorable attention and to find a ready sale. As an illustration of what this motor will do, one not much larger than an ordinary cigar box was recently placed on exhibition in a Providence leather establishment, and for several weeks it has been constantly running a heavy "What Cheer" sewing machine for working on leather. Only 45 pounds pressure, or about 1½ gallons of water per minute, does the work. In Providence, where the water rates are rather high (3c. per 100 gals.), the cost of running the motor has not exceeded an average per hour of 2¾ cents.

A few days ago the officers of the Narragansett Electric Light Company, of Providence, induced Mr. Carhart to allow a test of the motor to be made at the company's plant with steam as the propelling power. It is alleged that a speed of 4,500 revolutions per minute was reached by the motor on that occasion.

The Fire Alarm Box Controller Company, of Providence, R. I., Mr. Charles E. Bailey, president, is about to enter extensively into the manufacture of a new fire-alarm signaling apparatus, the invention of Mr. C. D. Rogers, an employé of the American Screw Company. It has been noticed in THE ELECTRICAL WORLD.

In one of my references to the Waterhouse Company last week, the compositors made the name read "Waterbury." The mistake was obvious, but as I am jealous of my fame for turning in good copy, I hereby note the fact. W. I. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, July 3, 1886.

The very satisfactory condition of business among the electrical manufacturers and dealers, which I referred to a few weeks ago, still continues in the West, and trade is all that could be desired. "Booming," "All we can attend to," "Never better," are some of the expressions I hear in going the rounds, and it is a matter for congratulation to be assured that the revival of a few months ago promises to be permanent.

My Indianapolis correspondent furnishes the following as the latest in regard to the telephone question there:

John Caven, as president of the Citizens' Co-operative Telephone Company, appeared before the committee on streets and alleys, with sundry objections to attempting operations under the ordinances as now constituted, and asking a modification of two of the sections. He claimed that the ordinance was the same one which the West syndicate refused to accept, and that it was so hedged with provisions that it made putting in and conducting a telephone plant a business impossibility. Among the objections was the provision requiring the company to secure the consent of the council before putting up poles on any special route; declaring the property of the company forfeited if the provisions of the ordinance were not fully complied with; giving the city a right to impose a special tax in case there was an injunction; allowing other companies to string its wires on the poles of the Co-operative Company; requiring work to begin within thirty days, and yet allowing an old company to obstruct the way, and forbidding the Co-operative Company to lease to any other company without

forfeiture of its privileges, and yet reserving the privilege of granting similar franchises to other companies. Mr. Caven further stated that it was supposed that the Central Union would be required to remove its plant, for it would require the Co-operative Company to erect poles 75 feet high, in order not to interfere with the other; further that capitalists declined to put money in a company subject to the whim of the Council, and liable to confiscation at every turn. He also called for a modification of sections 9 and 10, so that the company could have some assurance of holding its own property, and for such other changes as indicated above, and it was stated that Mr. Wallace, under whose patent the company proposed to operate, had indicated to the Central Union that if they would show how best to give ground for complaint, so that a suit might be brought against his patent, he would do his best to arrange for a trial in court, as he was anxious to test the matter at once. The committee took the suggestions as made by Mr. Caven under advisement, and will meet again immediately to frame a report. It was practically agreed by the committee that the provisions of the ordinance were too severe, and the City Attorney stated that inasmuch as the Central had violated its agreement with the city it could not come in under its charter and secure relief for injury to its poles and wires. The committee also did not take kindly to the present toll system, as inaugurated by the Central, holding that not only was the price increased, but every one taking a telephone was compelled to become a collecting agent for the company.

The Wallace people, it seems from the above, are not satisfied with their ordinance. They have not as yet taken a step toward building an exchange. The Central Union people report 475 subscribers under the agency scheme.

The Baltimore & Ohio Telegraph Company have opened an office in Terre Haute, Ind.

To-day is opening day for Cheltenham Beach, Chicago's new summer resort a few miles down the lake. The grounds will be illuminated at night by something like a hundred Ft. Wayne-Jenney arc lights.

The Great West automatic engine, built by the Madison Manufacturing Company, Madison, Wis., is an engine which is bidding for favor among electric light people.

The Railway Telegraph Supply Company have opened a general Southwestern agency at 210 North Third street, St. Louis, Mo., to accommodate their rapidly growing trade in that territory. The St. Louis branch will be under the management of Mr. P. C. Burns. Mr. Burns is energetic and popular, and will do much to increase the company's already large trade in that section.

The Chicago branch of the Brush Electric Company hands in the following partial list of late orders:

Aberdeen, Dakota, 60 arc lights.

Grand Forks, Dakota, two arc machines of 30 lights each.

Minnesota Iron Company, 60 arc light outfit for their Vermilion mines, and 20-light outfit for their shipping docks, at Two Harbors, Lake Superior.

Ashland, Wis., 60-light arc machine.

Whitbeck Lumber Company, Marinette, Wis., 30-light machine.

Kirby Carpenter Company, Menominee, Mich., 40 lights.

Waupaca, Wis., Electric Light Company, 40 arcs and 300 incandescents.

Black River Falls, Wis., 60 lights, arc.

Waterloo, Iowa, 45 arcs.

Marinette, Wis., Electric Light Company, 65 arc light outfit.

La Crosse Brush E. L. Company, 65 arc lights.

The specialties manufactured by Mr. H. A. Streeter, proprietor of the Globe Iron and Electric Engineering Works, are finding a large and steady sale. These include the Amet electric governor, current indicator, voltmeter and ammeter.

The operators of the fire-alarm telegraph office completed the testing of the lines and boxes last evening. The work required two weeks' time, and the boxes are now in perfect order.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following stock quotations:

Bell of Mo.	$147@$150
Chicago	350@ 360
Central Union	45@ 47
Colorado	18@ 20
Cumberland	65@ 70
East Tennessee	178@ 180
Great Southern	29@ 31
Great Southern Scrip, 90 cents on the dollar.	
Iowa Union	15@ 18
Michigan	63@ 65
Mo. & Kan.	54@ 56
Mo. & Kan. Scrip, 55 cents on the dollar.	
Rocky Mountain Bell	40@ 45
United	15@ 17
Wisconsin	103@ 105

W. A. K.

THE TELEGRAPH.

The Two Million Suit.—All the evidence in the Farnsworth suit is now in, and the counsel have summed up.

French Press Rates.—The telegraph rates to the press in the interior of France have been reduced one-half.

Japan.—A factory for the manufacture of telegraph wires and appliances is to be established at Tokio, Japan.

Railway Signals.—The Railway Automatic Signal Company, Chicago, has been incorporated; capital stock, $250,000; incorporators, Moses H. Naber, Sidney C. Eastman and Marcus Hitch.

German Press Rates.—The new telegraph rules regulating the tariff on telegrams within the empire are causing general dissatisfaction because of their arbitrary nature and the increased cost of the service.

A French West Indian Cable.—In the Chamber of Deputies last week M. Granet, Minister of Posts and Telegraphs, introduced a bill to authorize a company to lay cables between France and the French Antilles and Guiana. The Government guarantees interest on the capital, and the cables must be made in France.

Police Patrol Telegraphs.—Last September the Middle police district, Baltimore, was equipped by the Southern Electric Company with the Gamewell apparatus. The system has worked very satisfactorily, and the company has now executed a contract to make apparatus for equipping the Southern and Eastern districts.

Disquieting Rumors.—It is denied that the Eastern operators of the Associated Press have any desire to take part with their Western brethren in the demand for higher pay. A report from Washington states that at that point there is considerable talk among the operators of all grades of a probable general strike before the close of the summer—even by August 1.

Orders of Arrest.—Some severe remarks were made by Judge Barrett lately in relation to the arrest of alleged criminals by the police on telegraphic dispatches alone, and they have apparently had weight with police magistrates. At the Jefferson Market Police Court on July 3, Justice Smith refused to remand Frederick S. Allen, of Portland, Me., who had been arrested on a charge, made by telegraph, of swindling preferred by Robinson & Co., of Portland. Allen was discharged.

THE TELEPHONE.

Erie.—The Erie Telephone Company has declared a quarterly dividend of ½ per cent.

The Lowell Syndicate Suits.—The taking of evidence in these suits has been resumed. Mr. C. J. Glidden has been on the witness stand again.

New York Police System.—It is officially proposed to substitute telephones in New York for the police service in place of the dial telegraphs now used.

The Last Word?—The defendant companies in the Newark, N. J., case will prolong the litigation by an appeal to the Court of Errors and Appeals, whose next session is November 16.

Telephonic Evidence.—Judge Barclay, of the St. Louis Circuit Court, rendered a decision on July 1, declaring telephonic conversations to be admissible as evidence in court, even when the speaker's voice is not recognized. This is the first ruling on the matter in Missouri.

Figuring Out a Big Profit.—This comes from the Chicago *Tribune:* A man took out his pencil yesterday, and, after figuring for a moment, remarked: "The Chicago Telephone Company is capitalized at $500,000, with 5,000 shares of stock. This stock has jumped from a par value of $100 to about $400. Stock advances for one of two reasons. It must either be held by a determined clique at high rates, or must make sufficient money to pay big dividends. None of the Chicago Telephone Company's stock is for sale, nor has a share been sold for a long time. This shows that the stock is paying big dividends and is a bonanza to its owners. The majority is held by the Bell Telephone Company, of Boston, and the rest by the McCormick estate, the Stager estate, Norman Williams, John B. Drake and a very few others. Now, the Boston company never put up a cent, but got its stock for patents and privileges, and is carrying off Chicago money without conferring any benefits in return. The revenues of the company amount to about $600,000 per annum for some 5,000 phones in and out of the city. The expenses of the company, including construction and reconstruction, rental to the Boston Bell Company, service, etc., at the most cannot exceed $200,000 per year. This leaves $400,000 to be divided among 5,000 shares of stock, or a clear profit of $80 per share annually. Of this over $200,000 is shipped to Boston."

THE ELECTRIC LIGHT.

Baltimore, Md.—The lighting of the Crescent Club with 300 Swan lamps run off Faure storage batteries has begun with indications of success and long continuance.

Buying Up Plants.—Mr. J. Frank Morrison, of Baltimore, has bought up the Brush plants at Washington and at Williamsport, Pa., and has already transferred them to other points.

The Illuminated Fountain at St. George, Staten Island, described in these columns two weeks ago, is working admirably. The electric lights, totaling 150,000 candle-power, produce splendid effects. Mr. Wiman has thus made another big hit.

Jamaica, West Indies.—Mr. Ernest G. Craven, of Craven & Elsworthy, London, has arrived to introduce the electric light into the Island. The price of gas in Kingston is nearly $3 per 1,000 feet. The military authorities are putting in a plant of their own for the garrison at Port Royal. All this work ought to be done by Americans.

Litigation at Pittsburgh.—Judge Ewing dismissed on June 30 the bill in equity of the Brush Electric Light Company against the Allegheny Light Company, and ordered the costs divided. The action was brought on the violation of an alleged agreement by which the Allegheny Light Company was to purchase all its carbon points from the plaintiffs.

Underground Tests at Philadelphia.—The results with the lights on North Broad street, fed by underground conductors, under the supervision of Superintendent Walker, of the City Electrical Department, are very satisfactory. The service is good, and the cost is only fifty cents per lamp nightly. Besides the electric light wires, there are buried in this conduit other wires, making a total of eight miles of wire in the underground box. These will be eventually used for other purposes by the Electrical Department.

The Emission of Light.—Mr. Mortimer Evens thinks that the economy of light and the absence of heat emitted from an incandescent surface is solely due to the reflective efficiency of the surface itself, and not in any way to the material of which it is composed. Were we able, says Mr. Evens, to produce a perfectly reflecting carbon surface, or, indeed, a perfectly reflecting surface of any material capable of bearing the necessary temperature, I have little doubt but that an efficiency of 1½ or 2 watts per candle-power might be obtained, and this without any increase in the temperature or strain to the filament.

A Bungled Job.—A special cable dispatch of June 29 says: Thirty thousand people went last night to witness the performances in the immense bull circus at Nimes, in the department of Gard. The entertainment had been extensively advertised to be given under electric lights. The lights went out soon after the performances began, and, owing to the defective apparatus, could not be relighted. The people became enraged and began rioting. They tore down the fittings of the circus and made a bon-fire in the arena of them and the furniture. Troops had to be called to restore order, which they only succeeded in doing after a desperate conflict with the people, many of whom were wounded and arrested.

PERSONALS.

Col. R. G. Ingersoll is said to regard his great speech in the Farnsworth suit as one of his best efforts in a literary and forensic way. It is to be printed for general distribution.

Mr. Daniel L. Gibbons, private secretary to Mr. R. P. Flower, has been appointed counsel of the New York Electrical Subway Commission. Mr. Henry S. Kearney has been appointed supervising engineer.

Mr. Thomas J. Mayall, of Boston, a well-known New England inventor, has a new system of rapid transit, the motive powers being electricity, cables and air—especially the first. He is now getting his applications for patents ready.

Mr. S. M. Bryan, of the local Telephone Company, is having a fine house built in Washington. It will be ready about October, and will take high rank among the beautiful homes of the Capital. As might be expected, Mr. Bryan proposes to have all kinds of electric service, including the incandescent light.

MISCELLANEOUS NOTES.

Rupture of Insulating Materials.—Mr. Mordey does not think that Professor Fleming is right is supposing that the danger of rupture to insulating materials increases as the square of the electromotive force. Mr. Mordey's own experience in practical working has never revealed anything that would confirm such a supposition. We imagine not, for if our memory serves us aright, Professor Ayrton has employed no less than 14,000 volts in testing some of Henley's patent ozokerited India-rubber core. —*Lond. Elect. Rev.*

New York Subway Work.—A strong organization, duly incorporated under the name of the "Consolidated Telegraph and Electric Subway Company of New York City," fully prepared with strong financial and legal backing, will, it is said, come forward to bid for the work of carrying out the plans of the Subway Commission. This company was incorporated in 1884, Justice William H. Kelly at that time acting as its legal representative. The capital stock is $3,000,000, of which a fair proportion is already paid in. The organizers include many well-known Wall street men and bankers.

New Chloride of Silver Battery.—Mr. Warren de la Rue has arranged his chloride of silver battery in a new or dry form, which adapts it better for the purpose of maintaining small incandescence lamps alight. The cell consists of a flat glazed earthenware tray containing a sheet of silver foil on its floor. Dry powdered chloride of silver is spread over this plate, and a vegetable jelly is laid over that to support the zinc plate, which is the upper pole of the cell. This jelly is made by dissolving a solution of chloride of ammonium (2½ per cent. of the salt) in Ceylon moss or "Agar-agar." A pile of these cells makes a small convenient battery.

Collecting Doctors' Fees.—A young doctor is credited with the following: There's one man in New York who has a beautiful plan for getting his fees at once—gives his advice C. O. D., so to speak. He is a well-known specialist who has just completed a new house up town. In this house his office is so arranged that patients in going away pass out through an anteroom in which sits a nurse, ready to aid the physician in case of need, but always on duty as a collector. On the wall is an indicator, with dials numbered 5, 10, 15 and so on. Wires connect these dials with a row of keys on the physican's desk and the whole forms an electric circuit. See the scheme? No! Well, you see, after a consultation the physician is not obliged to mention with many hums and haws his little bill to his departing patient. He simply touches a key and the departing patient falls a prey to the nurse, who promptly collects $15 or $20 according to the indicator in the ante-room. Oh, it's a great plan, but it's a sad commentary on a profession that can only be made profitable by the assistance of electricity. By and by I suppose each doctor's office will be provided with one of those mysterious machines that by a single turn of a crank display a dial with the amount of the bill contracted; add this amount to previous receipts, and give a due bill to the debtor. You may have noticed such affairs in certain establishments where prescriptions are put up for immediate use.

SPARKS AND FLASHES.

A Bad Marriage is like an electric machine—it makes you dance, but you can't let go.

Small Pipes.—Country cousin, admiring the electric lights and the wires of them: Well, I be blowed, but they be offul small gas pipes, considering the light they give.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange and elsewhere are as follows:

Telegraph.—B. & M., b 2, a 3; Western Union, b 66⅝, a 66¾.

Telephone.—Am. Bell, b 195½, a 196; Erie, b 28¼, a 29 New England, b 37⅛, a 38.

Electric Light.—Edison, b 120, a 125.

BUSINESS NOTICES.

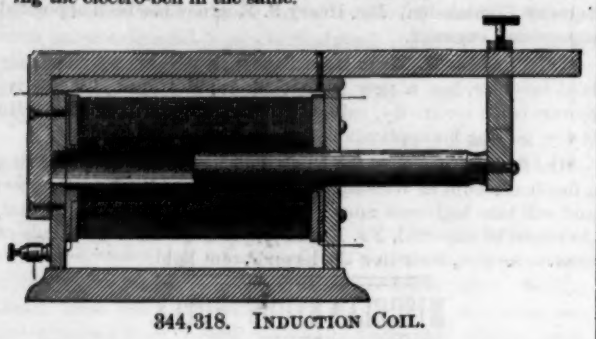
Pike's Toothache Drops
Cure in 1 minute; harmless, quick, thorough; no equal; 25c.
DEAN'S RHEUMATIC PILLS are a prompt, sure cure; 50c.
HALE'S HONEY, the great cough cure, 25c., 50c. and $1.
GLENN'S SULPHUR SOAP heals and beautifies the skin; 25c.
GERMAN CORN REMOVER kills corns and bunions; 25c.
HILL'S HAIR AND WHISKER DYE black and brown; 50c.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JUNE 22, 1886.

344,067, 344,333. Telephone; William C. Turnbull, Baltimore, Md. 1. A resonating box of peculiar construction is provided. 2. Two drums are provided and vibrating plates on each side of the drum, as shown in the cut.

344,072. Chronometer Electric Call; William L. Bailie and George H. Mills, Baltimore, Md. Consists of improvements in details in electro-calls governed by a chronometer, in which the electrodes of the circuit are connected at a prearranged time automatically, thereby closing the circuit and ringing the electro-bell in the same.



344,318. INDUCTION COIL.

344,096. Lightning-Rod Couplings; Edward A. Fox, Cincinnati, O. Comprises two hollow sockets provided, respectively, with a male and a female screw, with internal shoulders against which the ends of the rod abut, and with an alloy filling of high conductivity.

344,099, 344,100. Railway Signals; Burton H. Gedge, Covington, Ky. He provides insulated conductors in sections alongside of the track, and a battery and bell apparatus in the cab of each locomotive, communicating through a four-way switch operated by the reversing-lever of the engine, and through contact-brushes with said insulated conductors, and communicating with the rails or "ground" through a commutator operated by the men on the train.

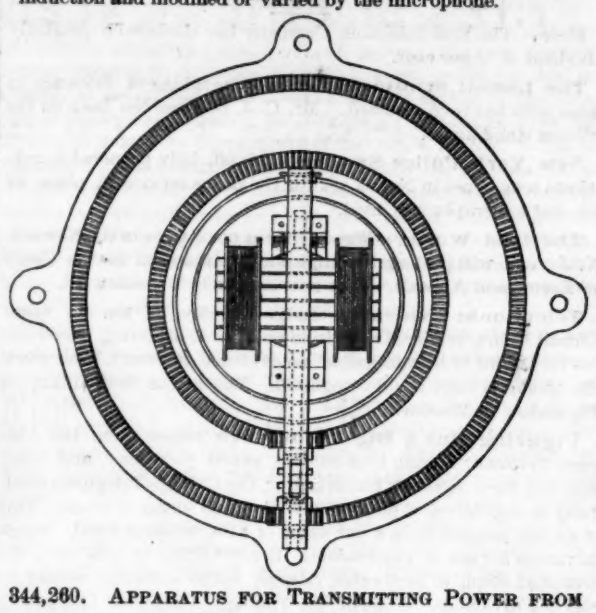
2. The said device comprises an insulated conductor placed alongside of the track in advance of the switch, and connected to "ground" by opening the same, and a battery and a bell on each locomotive included in an open circuit, one of whose terminals connects with aforesaid conductor in passing the same, the other terminal being, either intermittently or continually, connected to ground.

344,121. Water Level Indicator; Wilber S. Mayers, Fort Apache, Arizona. Consists in electro-mechanical means for transmitting the electrical impulse of one kind when the water rises, and of another kind when the water falls, and in electro-mechanical devices capable of being acted on by the two kinds of impulses to operate registering mechanism to show the rise and fall in the level of the water.

344,153. Telephone; Jules J. Barrier and Ferdinand T. De Lavernède, Paris, France. Consists in the construction of a

344,333. TELEPHONE RECEIVER.

combined microphone and magneto-telephone without the use of a battery, the operative current being produced by magneto-induction and modified or varied by the microphone.



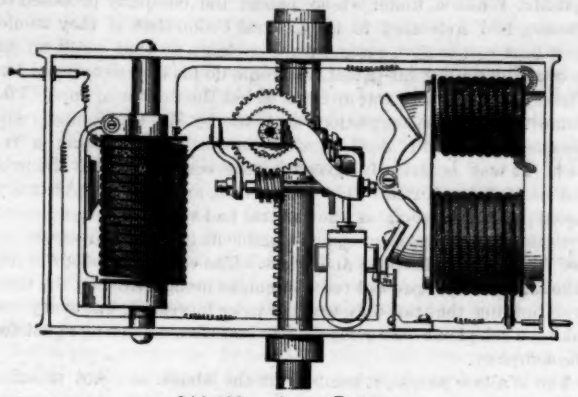
344,260. APPARATUS FOR TRANSMITTING POWER FROM ELECTRIC MOTORS.

344,188. Arc Lamp; Norman McCarty, Hoosick, N. Y. The construction and electrical connections are shown in the cut.

344,233. Alarm; Carlos M. Barnes, Enosburg, Vt. Consists of details of construction of an alarm for calling guests at a hotel.

344,318. Induction Coil; Francis W. Jones, New York, N. Y. The adjustable core and opposite magnetic pole are joined magnetically, as shown in the cut.

344,324. Conduit; James F. Munsie, Chicago, Ill., Assignor



344,188. ARC LAMP.

of $\frac{3}{14}$ to Horatio N. May, same place. It has an irregular longitudinal slot or opening in the top, closed by a removable bar.

344,252. Arc Lamp; Joseph R. Dales and Wyllis H. Markland, Altoona, Assignors to Monroe K. Reeves, Philadelphia, Pa. Consists in combining with two swinging arms which form carbon holders, a wheel and pinion whose diameters differ, said wheel and pinion intermeshing and their shafts forming the fulcra of said arms, whereby when said shafts are rotated the arms will be moved unequal distances, respectively, and will feed one carbon faster and farther than the other.

344,260. Motor System; Chaimsonovitz P. Elieson, London, Eng., Assignor to the Electric Locomotive and Power Company (Limited), same place. The disposition is shown in the cut.

10,738. Arc Lamp; Otto Romanye, London, Eng., Assignor to Mason, Thornton & Romanye, of same place. Reissue of patent 330,351, Nov. 10, 1885.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, N. Y.

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NOTICE.

Tenders for Fire-Alarm Telegraph.

Tenders addressed to the undersigned will be received by registered post up to noon of Monday, the 26th day of July next, for a complete new Fire Alarm Telegraph system, comprising a three-dial manual or a ten-circuit non-interference automatic repeater, with attachment for four alarm circuits, switch-boards, galvanometers, keys, bell magnets, and all necessary apparatus for a central office; ten 15-inch engine house gongs, 120 non-interference signal-boxes with lightning-arresters, test-switches, trap-locks and bell-strikers. The whole to be delivered in the City of Toronto free of duty and transportation charges, and put up in first-class order ready to be attached to the several circuits. Tenders to state the kind of repeater and boxes proposed to be furnished. Each and every tender must be accompanied by a marked check or cash deposit equal to 2½ per cent. of the amount thereof, which will be forfeited to the city in the event of the person whose tender is accepted failing to execute the necessary contract or give satisfactory sureties for the due fulfillment of the same. Deposits of unsuccessful tenderers will be returned. The lowest or any tender not necessarily accepted.

JOHN MAUGHAN,
Chairman Fire and Gas Committee.
CITY CLERK'S OFFICE, TORONTO, June 23, 1886.

NOTICE.

Sealed proposals will be received at the office of the Board of Trustees of the Toledo Insane Asylum, Room No. 18, St. Clair Building, City of Toledo, Ohio, until August 2, 1886, at 12 o'clock M., for furnishing and putting in place all the machinery and apparatus, including engines, dynamos, lamps, conductors, switches, regulators, and all other fixtures and appliances required for successfully lighting the asylum buildings by incandescent electric light. Parties will accompany their bids with plans and specifications fully setting forth and explaining, in detail, the system of electric lighting proposed to be furnished by them. Drawings and plans of the site and of the several buildings to be lighted can be seen at the office above named.

The Board of Trustees reserve the right to reject any or all bids and waive defects. Appropriation, $18,000.

J. W. NELSON,
President of Board of Trustees.
WALTER PICKENS,
Secretary.
TOLEDO, O., July 2, 1886.

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SPECIAL NOTICE.

National Electric Light Association.

SEMI-ANNUAL MEETING.

The Fourth Meeting—Semi-Annual—of the National Electric Light Association will be held at Detroit, Mich., on Tuesday, Aug. 31 next, at 10 o'clock A. M.
Dues being payable in advance, all members are required to forward the same for the year 1886, by check or otherwise, payable to the order of J. F. Morrison, President, Baltimore, Md.
Electric Light Companies and Manufacturers of Electric Light Apparatus, supplies, etc., desiring to become members must apply on or before Aug. 31 to the President, J. F. Morrison, Baltimore, Md.
Members and others desiring information as to railroad transportation rates will address J. F. Noonan, Esq., Chairman Committee on Transportation, Paterson, N. J.
Special hotel rates will be made known previous to meeting of the Association.
A. J. DE CAMP,
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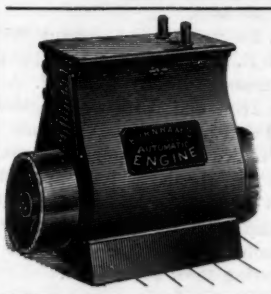

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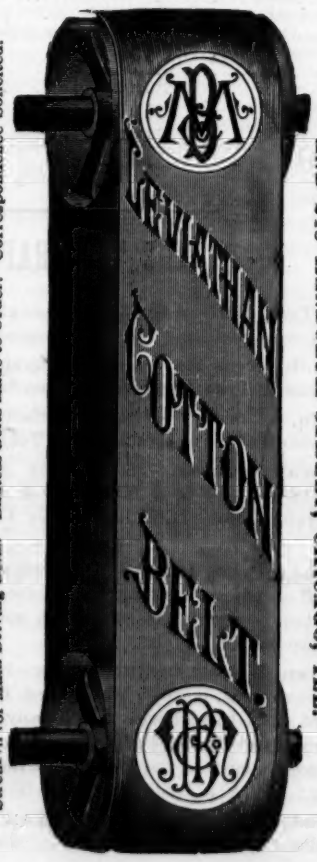

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